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INTERNATIONAL MONETARY FUND

CANADA

Selected Issues

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Approved by Western Hemisphere Department

January 25, 2013

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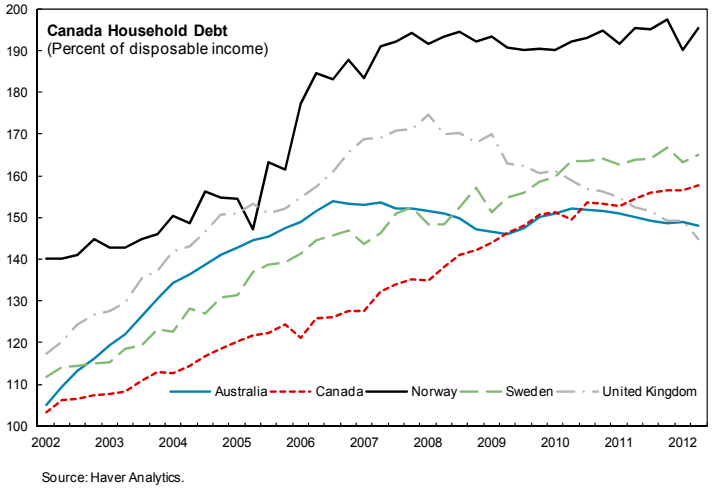
I. Assessing The Impact of High Household Debt on Economic Volatility In Canada[1]

A. Introduction

1. **To what extent is the increase in Canada's household leverage a matter of concern?** Other advanced economies (for example, Australia, Norway, Sweden, and the United Kingdom), experienced similar or even larger increases in household debt-to-income ratios during the last decade and faced very different outcomes during the Great Recession. In principle, it is not immediately obvious why higher gross household debt should be a problem, especially if the increase in leverage is matched by higher gross asset positions and an increase in net wealth (IMF, 2012, and Dynan, 2012). And there is no clear threshold above which household leverage can be defined "excessive". Moreover, as discussed in the staff report, while house prices seem somewhat overvalued at the national level in Canada (Box 1), the risk of a severe housing bust is reduced by the strong balance sheet and conservative lending practices of Canadian banks, the recourse nature of mortgage loans, and the broad scope of government-backed mortgage insurance.



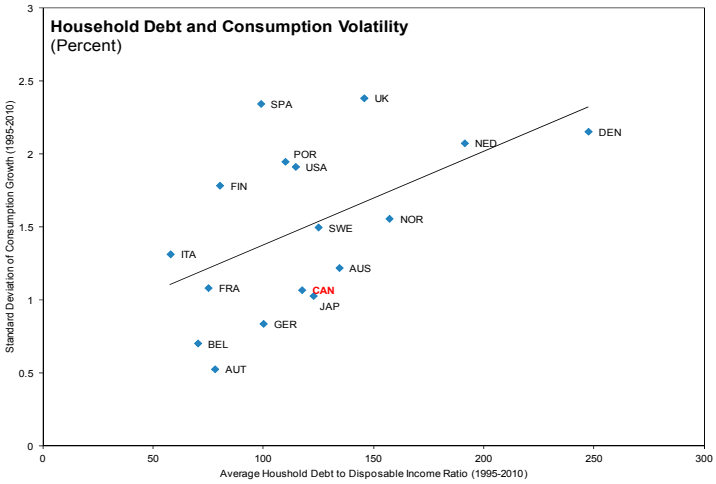
2. **While high household debt per se might not necessarily be a risk for economic activity, it could amplify the vulnerability to other shocks to the economy**. This chapter first reviews cross-country evidence on the link between high household debt and macroeconomic volatility, especially consumption volatility. This evidence suggests that economies with higher household debt tend to exhibit higher consumption volatility under different adverse shocks. Large household leverage positions can become problematic in case of a sharp decline of asset prices (particularly housing), labor income or other negative shocks, as they can lead to significant household deleveraging in the context of lower net wealth and tighter credit conditions, with a negative impact on consumption and overall economic activity. The chapter then quantifies the vulnerabilities associated with high household debt in Canada, using a macroeconomic model that incorporates housing market variables and mortgage debt. In particular, the model is used to illustrate how different

[1] Prepared by Pau Rabanal (ICD).

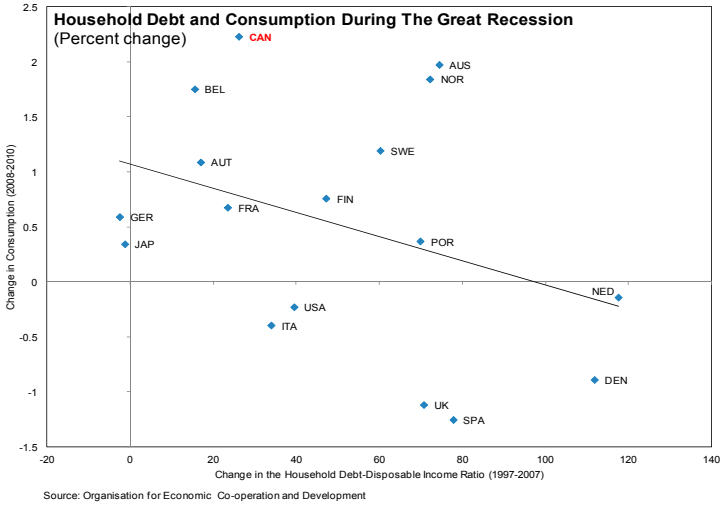
adverse shocks could be transmitted to the Canadian economy in a high- and low-household debt scenario.

B. Household Debt and Economic Volatility: Empirical Evidence

3. **There is a strong empirical link between household debt and consumption volatility.** In a recent cross-country study, Isaksen et al. (2011) find a strong positive relationship between household debt levels and consumption volatility in 19 OECD economies over the last two decades (chart on the right reproduces their evidence). Higher household debt may amplify economic fluctuations as negative shocks on asset prices tend to have a stronger effect on the asset side of household balance sheets than on the liability side, thereby reducing net wealth. To the extent that higher aggregate household debt is associated with more households at their borrowing constraint, these shocks may lead to more volatility in consumption, as they affect the ability of highly leveraged households to access new credit. As highly leveraged households tend to have higher marginal propensities to consume, aggregate consumption may fall more than would have been the case under lower leverage.



4. **A few studies have emphasized the link between the growth of household debt before 2007 and the severity of the Great Recession**. IMF (2012) and Glick and Lansing (2010) find that countries where household debt increased faster before the Great Recession suffered larger drops in private consumption afterwards (text chart updates Glick and Lansing's evidence). Mian and Sufi (2011) focus on 238 counties in the United States, as this may help identify the causal effect of household debt by controlling for macroeconomic policies. Their main finding is that the depth and the duration of the recession across these counties were highly correlated with pre-crisis household debt growth. In



Source: Organisation for Economic Co-operation and Development

particular, auto sales, residential investment, and employment declined more in counties with higher household debt. Using household level data, Dynan (2012) shows that highly leveraged U.S. households suffered larger declines in spending than their less leveraged counterparts despite having smaller changes in net wealth. This suggests that household leverage weighed on U.S. consumption above and beyond what would have been predicted by wealth effects alone.

5. **More generally, economies with high household debt tend to experience more severe housing busts and recessions**. IMF (2012) studied 99 housing busts episodes in OECD economies between 1980 and 2011, and found that the episodes preceded by a larger (above "median") run up in household debt were associated with a more pronounced deleveraging process, a larger decline in consumption, a greater increase in unemployment, and a sharper fall in overall economic activity (Figure 1 reproduces this evidence).[2] The same result holds when considering more general recession episodes, rather than simply housing-bust episodes.

C. Household Debt and Economic Volatility: Model Simulations

6. **In this section we simulate the impact of shocks on a macroeconomic model of the Canadian economy with different levels of household debt.** We consider a small economy model which includes residential investment and house prices.[3] In this model, a fraction of agents are impatient and have preference for early consumption, and use housing as collateral. Higher house prices improve impatient households' balance sheets, reduce the probability of default, and thus the spread between lending and deposit rates. Improved borrowing conditions lead to increased demand for all types of goods and further house price appreciation. This model is similar to those featured in a few papers from the Bank of Canada. In particular Christensen et al. (2009) estimate a small open economy model with borrowing constraints using Bayesian methods and Canadian data, and show that the presence of borrowing constraints improves the empirical performance of the model. Following that paper, in our baseline calibration we set the loan-to-value (LTV) ratio to 80 percent, and the fraction of borrowing households to 40 percent.[4] To illustrate the role of

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[2] The impulse-responses are based on single equation regressions that include the macroeconomic series of interest (consumption, unemployment and GDP) as a dependent variable, and a housing-bust measure in the set of independent variables. See IMF (2012) for methodological details. The "median" is an increase of about 6½ percentage points of the household debt-to-income ratio over the three years leading up to the bust.

[3] The model is a small open economy extension of Kannan et al. (2012) and Quint and Rabanal (2012). See also Aoki et al. (2004) and Suh (2011). For more details on the model see Quint and Rabanal (2012).

[4] In principle, the calibration of the LTV ratio should be to the maximum LTV attainable (which for Canada is 95 percent) as borrowers in the model always borrow up to the maximum LTV. However, a lower LTV ratio is a better approximation to the actual aggregate household leverage in Canada, as not all households borrow to the upper limit.

household debt in the model, we consider the case where the LTV ratio is 95 percent, and the case where the LTV ratio decreases to 60 percent.[5]

7. **A fall in housing demand and a negative export shocks have a much higher impact on consumption in the high-household leverage Canadian economy**.

- ***A negative housing demand shock.*** We consider a 10 percent (q/q, annualized) fall in nominal house prices, which leads to a 15 percent decline of residential investment on impact.[6] This shock affects consumption through three channels. First, lower production in the housing sector means lower demand for labor and thus real wages in that sector, affecting households' disposable income and consumption expenditures. Second, households redirect spending towards non-durable goods, increasing personal consumption. These two effects will affect the decision of both borrowers and savers. Third, borrowers will face higher lending rates as lower house prices reduce their net wealth, and thus reduce borrowing and spending. In the baseline case, private consumption growth falls by about ¾ of a percentage point below the long-run growth rate (Figure 2).[7] In a high-debt environment the effects are much larger, and consumption growth falls by 2pps below the long-run rate.[8] The volatility of residential investment also increases in the high-debt economy. In particular, residential investment growth (q/q, annualized) falls by about 4 pps more in the high LTV ratio economy. In a low-debt economy, the housing bust barely affects consumption, consistent with the empirical evidence discussed in IMF (2012) and reproduced in Figure 1.

- ***A negative foreign demand shock***. We consider a 10 percent (q/q, annualized) decline in real exports. Growth in wages and disposable income slow, and this reduces both personal consumption and residential investment (Figure 3). The decline in house price sets in motion the accelerator effects for borrowers. In the low-debt economy, the result is a ¾ of a percentage point drop in private consumption, and a

[5] Two additional important parameters that determine the size of the financial accelerator in our model are: (i) the steady-state default probability, which we set to 1 percent; and (ii) the average recovery rate on a defaulted loan, which is set to 70 percent, on the upper side of estimates for the United States (see Mortgage Bankers Association, 2008).

[6] The model is hit with a one-time shock with a high persistence parameter (0.985). This implies that the half-life of the shock is 48 quarters. It is worth emphasizing that highly persistent shocks have a long-lasting effect on the *level* of variables, but not on their *growth rate*. A series of one-time shocks would be needed to cause a sharp fall in house prices and a more severe contraction of the growth rate of personal consumption.

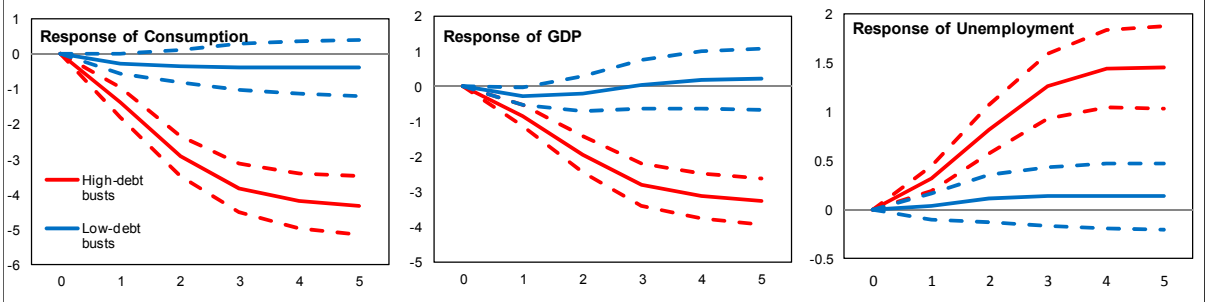
[7] In the model, real consumption, residential investment, CPI, and nominal house prices all grow at a long-run (steady state) rate of 2 percent.

[8] These results are consistent with the simulations of the Christensen et al. (2009) model. See Christensen (2011).

2pps fall in residential investment on impact. But in the high-leverage economy consumption declines by 1½ pps and residential investment declines by 3½ pps.

8. **If household debt ratios are not stabilized, the vulnerability of the Canadian economy is likely to be high under adverse shock scenarios.** The model is used to quantify the impact of a fall in house prices and external demand on the staff's forecasts of personal consumption and investment. As discussed in the staff report, our forecasts assume that the estimated 10 percent overvaluation (by end-2012) in real house prices will be unwound gradually over the next five years. The staff's baseline forecast is shocked with the same negative housing and external demand shocks discussed above. With the 10 percent additional decline in nominal house prices, the unwinding of the housing imbalances is accelerated relative to our forecasts (the 10 percent real house price overvaluation discussed in Box 1 of the staff report is absorbed by end-2013 rather than by end-2017). The fall of private consumption relative to what we have in the forecasts is about four times larger when the average LTV is high (95 percent) than when it is low (60 percent) (Figure 4). The difference is less dramatic in the case of the negative export shock, but still implies a larger reduction of consumption when household debt is high. Interestingly, the external demand shock has an important negative effect on residential investment when leverage is high, almost doubling the impact compared to the low-debt case.

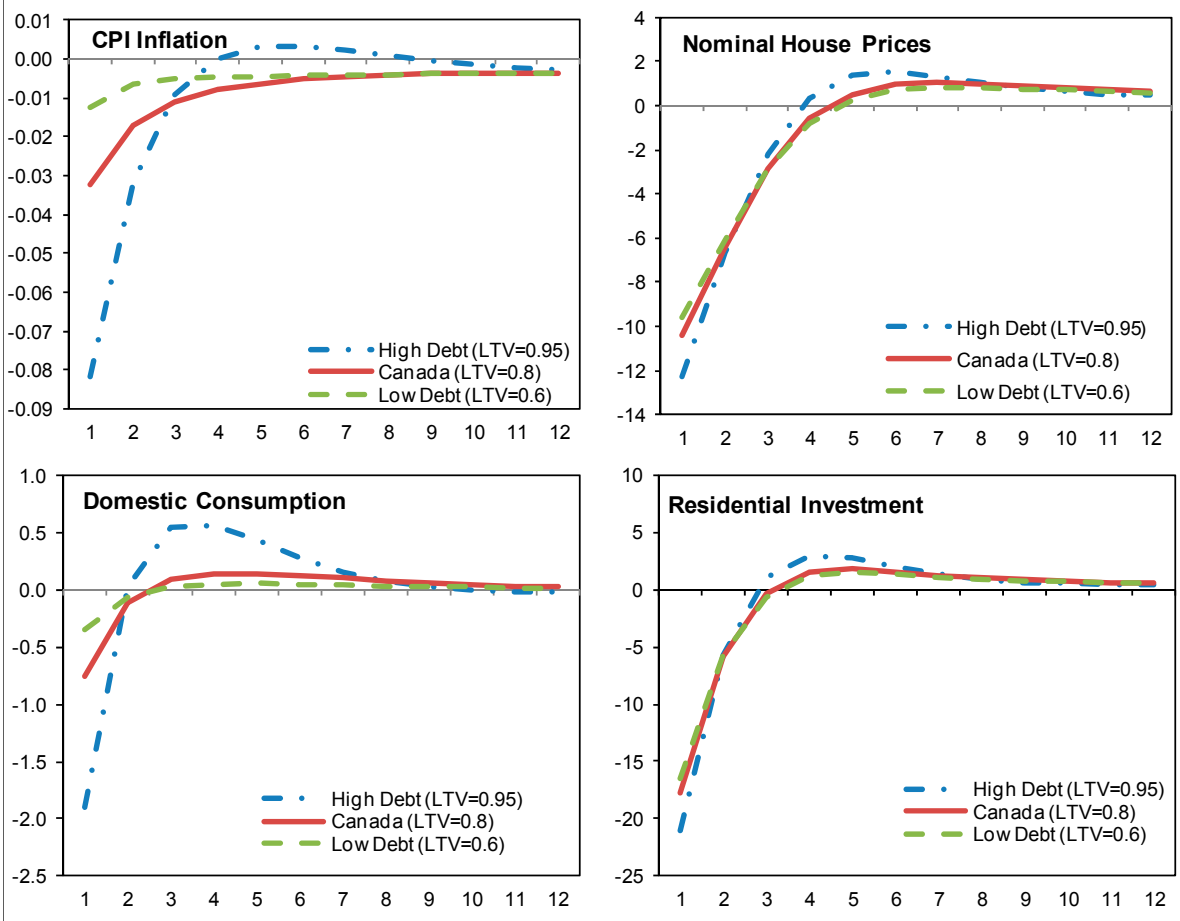
Figure 1. Impulse Response After a Housing Bust in High- and Low-debt Countries



Source: World Economic Outlook April 2012.

1/ Dashed lines represent +/- one standard deviation bands.
2/ X-axis denotes quarters after shock.

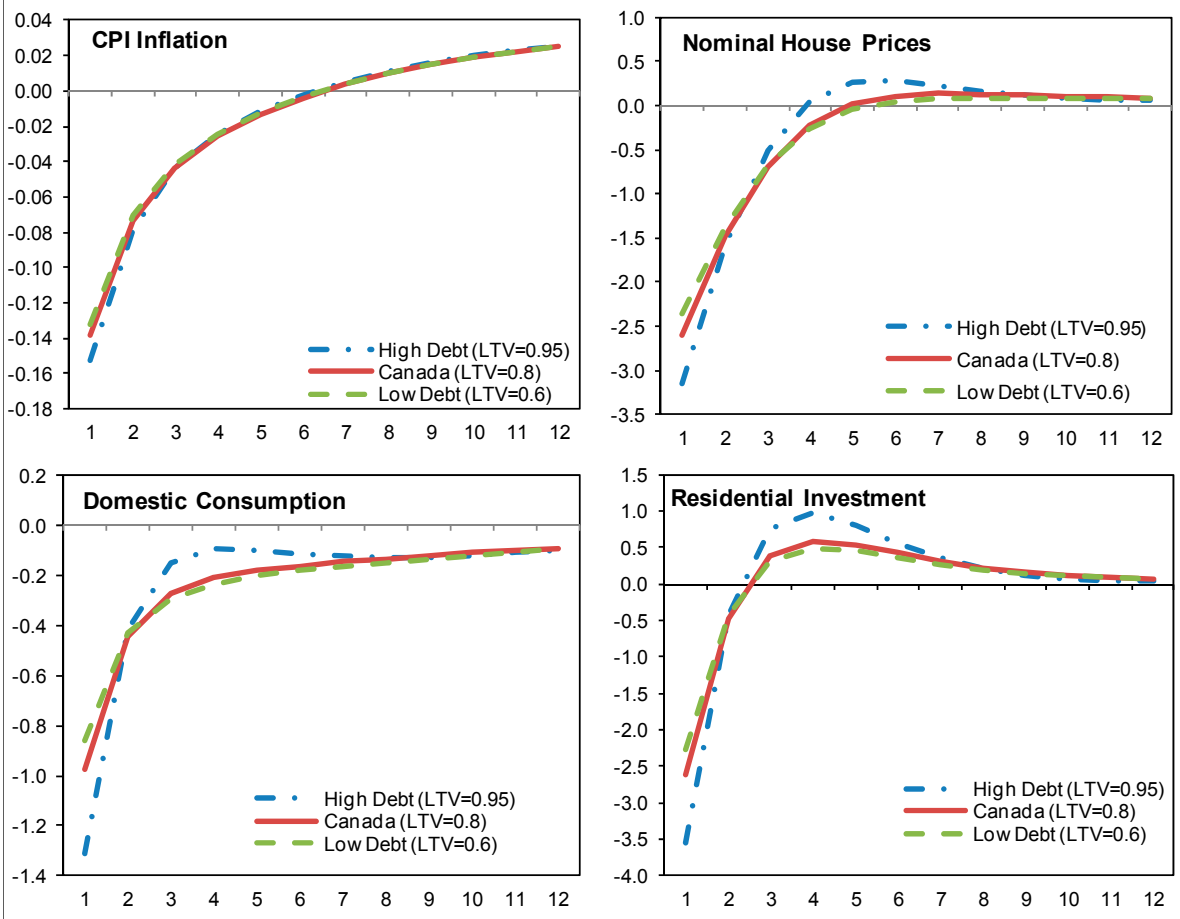
Figure 2. Impulse Response to a Housing Demand Shock
(Q/Q, annualized rates, deviations from long-run rates of 2 percent)



Source: Fund staff estimates.

1/ The X-axis denotes quarters after the shock.

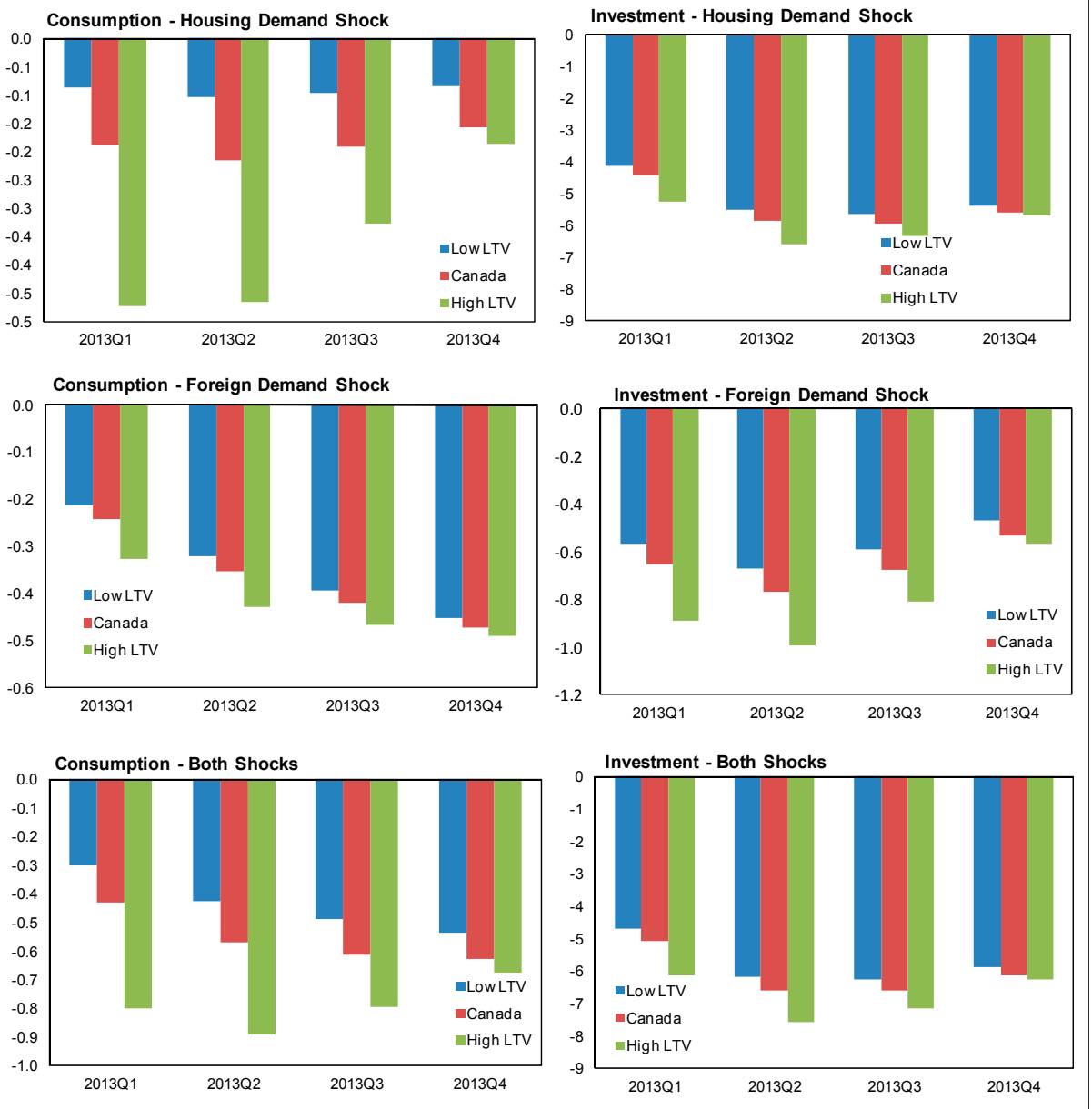
Figure 3. Impulse Response to an External Demand Shock
(Q/Q, annualized rates, deviations from long-run rates of 2 percent)



Source: Fund staff estimates.

1/ The X-axis denotes quarters after the shock.

Figure 4. Deviations from Staff Baseline After Housing and External Demand Shocks
(Percent deviations with respect to the staff's baseline scenario)



Source: Fund staff estimates.

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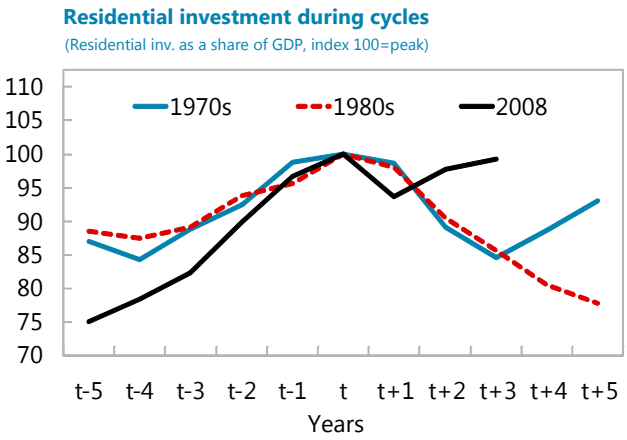
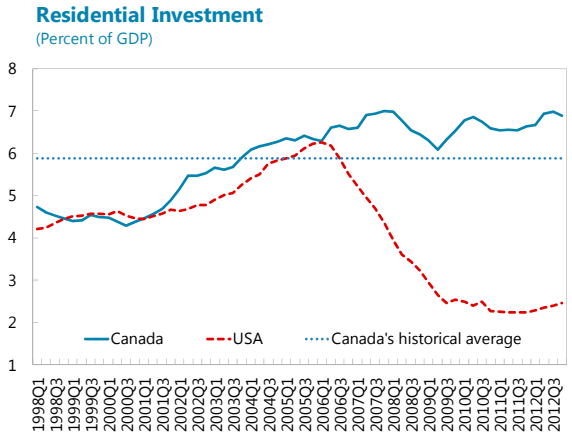
II. Is There an Excess Supply of Housing in Canada?[1]

A. Introduction

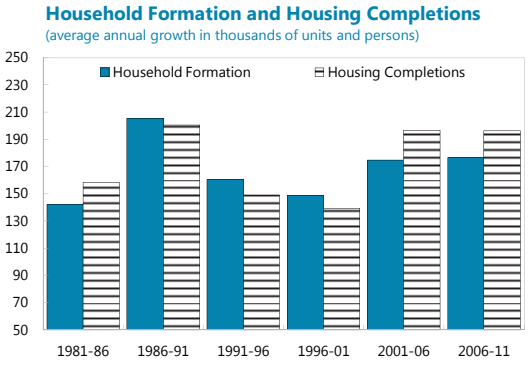
1. **Residential investment in Canada recovered quickly from the 2008–09 recession and, at about 7 percent of GDP as of Q3:2012, is well above its historical average.** Thanks to strong monetary and fiscal stimulus measures, it took only a year and a half for Canadian residential investment to return to its pre-recession level, against the average 3 to 4 years in previous cycles (chart, left). After recovering from the recession, residential investment as a share of GDP continued to increase and reached a two-decade high in 2012 (chart, right).





Sources: Haver, Fund Staff calculations

2. **The strength of construction activity has raised concerns of possible overbuilding and excess supply.**[2] According to CMHC, the construction sector added 175 thousand new housing units per year on average over the last three decades in Canada, while household formation grew at an average annual estimated rate of 165 thousands, as derived from CENSUS data (chart). Over the last decade, however, housing completions averaged



Sources: CMHC, Census, Fund Staff estimates.

[1] Prepared by J. Reynaud, with research assistance from T. Mahedy (all WHD).

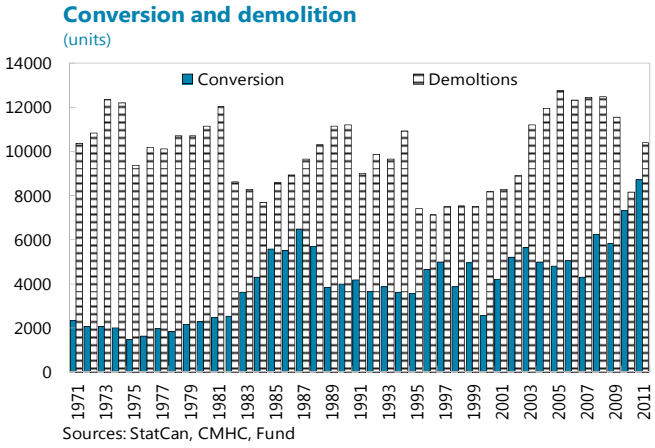
[2] In this chapter, "overbuilding" is a flow measure, describing the excess of housing units added to the market relative to the level consistent with the demand for new units. "Excess supply" is a stock measure, defined as the number of housing units in excess of the overall demand for houses. See the Appendix for details.

200 thousands units per year while household formation averaged at around 175 thousands, raising concerns of a possible overbuilding.

3. **This chapter estimates Canada's housing stock to determine whether there is an excess supply of housing**. To do so, we proceed as follows: first, we construct time series of Canada's housing stock and household formation. This allows us to estimate the vacancy ratio, a commonly used measure of excess housing supply. Second, we estimate an empirical model where the change in housing stock is a function of a set of underlying fundamentals (including household formation, household disposable income, construction costs, mortgage rates, and house prices growth). Overbuilding is thus derived by comparing actual data with the predicted values of the model. The results reveal some overbuilding, particularly during 2004–2008 and since mid-2011. As of Q3:2012, Canada's housing stock is found to be at 1½ percent above the level consistent with fundamentals.[3]

B. Estimating Canada's Housing Stock

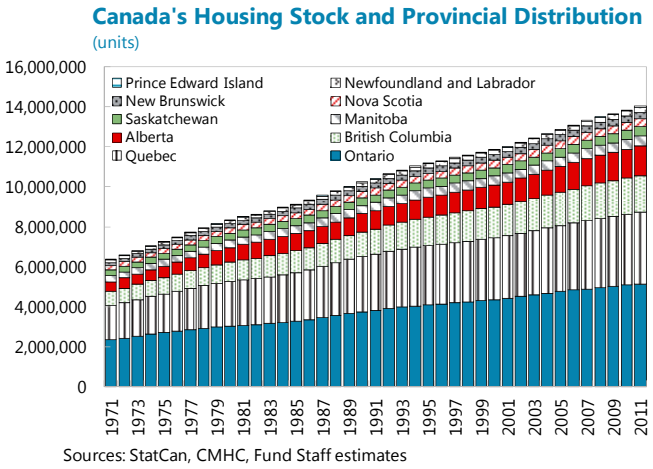
4. **In order to assess the current level of housing supply, we reconstructed a time series of housing stock in Canada**. Statistics Canada provides data on the total net stock owned and rented, total vacant dwellings for rent or for sale, and occupied stock owned and rented, at both national and provincial level, until 2000 only. We extrapolated the series to the years that follow and up to Q3:2012, adopting the same methodology (see the Appendix I for details). In particular, the housing stock in period *t* is defined as the stock in period *t-1*, plus newly added units (completions) and conversions (or additions), and minus demolitions.[4] The behavior of both conversion and demolition vary over time and with the housing cycles (chart). During the housing boom in the late 1980, conversions were large contributors to the change in net housing stock, while demolitions rose to historic highs during the pre-crisis period (2002–2008).



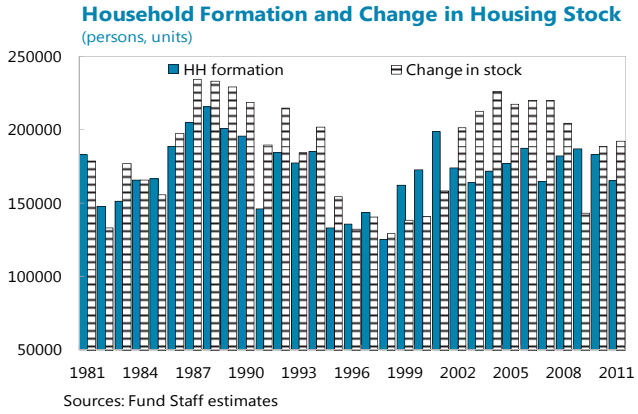
[3] Box 1 in the Staff Report discusses how we expect this gap to close over the next few years, given staff projections of the key variables in the model.

[4] Because of the lack of information on the timing of conversions, we assumed all conversions occur within one year. In reality, some of them can take up to 3 years, depending on the size of the building. Our assumption, however, is unlikely to have a large impact on the housing stock and on our yearly estimates of overbuilding, as conversions represent a relative small share of the overall number of new housing units added per year.

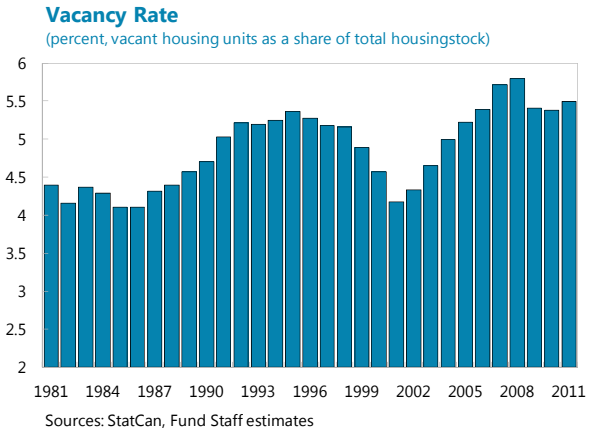
5. **The results show that Canada's housing stock more than doubled since the 1970s, with Alberta and British Columbia posting the largest gains**. Between 1971 and 2011, Canada's housing stock grew at a yearly average rate of 2 percent. The largest provinces posted the most dynamics trends, with Alberta and British Columbia growing at an average yearly 3 and 2.6 percent respectively (chart). This strong growth was at the expense of smaller provinces whose share in the total net stock diminished over the period. Ontario and Quebec shares of the national stock stagnated over this period, at around ⅓ and ¼ respectively.



6. **The growth of Canada's housing stock has outpaced household formation over the last decade** (chart). We interpolated 5-years CENSUS household series to compare yearly household formation with the yearly change in the housing stock. Over the last decade, the cumulative supply of new housing units outpaced the (demographic-related) demand for housing by about 10 percent.



7. **As a result, vacant housing units are currently at historically high levels** (chart). With estimates for household formation and the stock of housing, we can derive the vacancy ratio, that is, the number of unoccupied units as a share of the housing stock. The lack of reliable data on second homes (whether they are occupied or not) makes it difficult to get an estimate of the "natural" number of unoccupied houses in Canada (that is, the share of units that remain unoccupied due to frictions in the housing market when the latter is at equilibrium). Yet, assuming this share is relatively small and constant over time (in line with what can be deduced from the occasional Survey of Financial Security from Statistics Canada), we can take the difference between the



vacancy ratio and its historical average as a measure of the degree of disequilibrium in the housing stock. Doing so suggest an excess supply of housing of about 1½–2 percent (of the total housing stock) as of end 2011. While informative, these findings are based solely on demographics and thus fail to capture the influence of other determinants of construction activity. In the next section we turn to a model-based analysis of housing stock, taking into account a few factors that are commonly believed to influence the supply and demand for housing.

C. A Model of Canada's Housing Stock

8. **We estimate an empirical model of the housing stock.** In line with the literature (Egebo et al., 1990, Demers, 2005, Dupuis and Zheng, 2010, and Dagher and Reynaud, 2012), we estimate a model where the change in housing stock is a function of a set of economic fundamentals that include household formation, real construction costs, real household disposable income, the real mortgage rate, and real house price growth. We use quarterly data over the Q2:1984–Q3:2012 period, based on data availability, and estimated the model using OLS. All variables are in logarithmic form, except the real disposable income (an index) and both the mortgage rate and real house price growth (percentages) (see the Appendix for data sources).[5] They all enter the regression lagged by 4 quarters, to limit potential endogeneity issues and seasonal effects. Real house prices growth is calculated as a 2-year moving average. The construction cost series is proxied by the quarterly rate of increase of unionized workers in the construction sector, since wages represent the largest share of construction cost. The estimation results show that the demand component, i.e. household formation, is the main determinant of the change in the stock of housing (Model A, table). As expected, construction costs and the mortgage rate are negatively related to changes in the housing stock as they decrease the profitability of residential investment. In Model B, we introduce the change in real house prices. As expected, they influence positively the changes in housing stock as

Dependent variable: Δ housing stock		
Independent variables:	Model A	Model B
Household formation	0.739	0.406
	(0.127)	(0.145)
Disposable incomme per capita	0.022	0.019
	(0.005)	(0.004)
Construction cost	-0.012	-0.018
	(0.002)	(0.002)
Mortgage rate	-0.043	-0.068
	(0.016)	(0.014)
House prices		1.071
		(0.146)
Constant	-0.385	-0.361
	(0.140)	(0.135)
R-squared	0.370	0.527
N	113	113

Standard deviations in brackets.

[5] The real disposable income per capita enters the regression as an index to avoid collinearity with the mortgage rate variable.

expectations about the profitability of residential investment are positively correlated with expectation of price increase.

9. **Construction activity has been significantly above the level predicted by our model since 2002.** Model B captures well past episode of boom-bust cycle, such as the one at the end of the 1980s, while over-predicts the housing stock at the end of the 1990s, possibly as Canada's housing sector was still adjusting from previous excesses. On average over the sample period, the model suggests an excess-supply of around 200 thousands units—slightly more than a full year of construction at current levels. When focusing on the 2002–2012 period, this number rises to almost 400 thousands, representing about 20 percent of the change in housing stock over this period. As of Q3:2012, the model suggests that the housing stock is about 1½ percent above the level consistent with fundamental, down from its peak of 3 percent at the end of 2008.[6]

10. **Overbuilding has been concentrated in Ontario and Quebec, and to a lesser extent in British Columbia.** Lack of data, in particular on construction costs, limits the scope for estimating our model at the provincial level. However, using yearly frequency, we can estimate Model B over the 1992–2011 period for each Canadian province. The estimated (aggregated across provinces) degree of overbuilding is in line with the national estimate.

D. Conclusions

11. **The last time residential investment-to-GDP ratio reached 7 percent, the Canadian housing sector went through a long period of stagnation.** With current house prices and construction activity at historical highs, an adjustment is likely to take place in the coming years. This chapter analyzes the dynamics of the housing stock in Canada and found that Canada experienced some overbuilding when house prices and construction were booming, between 2002 and 2008. While there was an excess supply of housing of about 3 percent of the total stock at the end 2008, that excess has fallen to about 1½ percent as of Q3:2012.

[6] Dupuis and Zheng (2010) found that the Canadian housing stock was in excess supply by about 2 percent as of 2008.

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APPENDIX I. HOUSING MODEL, DATA DEFINITION, AND DATA SOURCES

The stock of existing housing (H_t) is the sum of occupied units O_t, or equivalently the number of households, and vacant units V_t:

$$H_t = O_t + V_t$$

Occupancy in period t is defined as the occupancy in period t-1 plus net household formation (HF_t^n):

$$O_t = O_{t-1} + HF_t^n$$

$$HF_t^n = IN_t - OUT_t$$

where IN_t is the number of newly occupied units, or *gross household formation*, and OUT_t

the newly vacated units.

Vacancy in period t is defined as the vacancy in period t-1 minus net household formation (HF_t^n) and demolition (DEM_t) plus newly built units NEW_t and newly added units, or additions, ADD_t:

$$V_t = V_{t-1} - HF_t^n - DEM_t + NEW_t + ADD_t$$

Excess supply is defined as:

$$H_t - H_t^* = (O_t - O_t^*) + (V_t - V_t^*)$$

where $(V_t - V_t^*)$ is the excess vacancy, i.e. the difference between the current level of vacant units and its normal or equilibrium level, a measure commonly used to gauge the potential for construction activity. $(O_t - O_t^*)$ is the excess occupancy that occurs when household formation is above equilibrium.

Overbuilding is defined as the difference between the net change in the stock and net household formation. As the addition of new housing units is feeding the vacant housing segment in the first place, overbuilding appears when $(NEW_t + ADD_t - DEM_t) > HF_t^n$. This translates into $V_t > V_{t-1}$, which should ultimately increase the housing stock above the level determined by household formation when $(O_t = O_t^*)$.

Surprisingly, there is a relative lack of publicly-available data of housing indicators in Canada, particularly on the housing stock, vacancy and occupancy ratios, and household formation. Series on the housing stock in Canada have been discontinued in 2000 and the only measure of the vacancy ratio, i.e. the ratio of non-occupied units to the total stock of houses, is for apartments in metropolitan areas. CENSUS Canada provides household formation estimates only every five years.

Starting from the latest available data of the housing stock in 2000, we follow StatCan definitions and estimate the series up to 2012. The equation below describes the estimate of the stock for 2001:

$$H^{e}_{2001} = H_{2000} + NEW_{2001} + ADD_{2001} - DEM_{2001}$$

where the (NEW_t) is defined as completions, (ADD_t) as conversion, and (DEM_t) as demolitions in the table below:

Data	Title	Source
Stock	Housing stock, dwelling units by type of dwelling and tenure, annual (units).	Statistics Canada: Table 030-0001
Completion	Housing starts, under construction and completions, all areas, annual (units)	Table 027-0009 Canada Mortgage and Housing Corporation
Conversion	Building permits, residential values and number of units, by type of dwelling, annual	Statistics Canada. Table 026-0001
Demolition	Building permits, demolitions by region, annual (units)	Statistics Canada. Table 026-0012. Note: Demolition data at the provincial level after 2000 is derived from CANSIM series of demolitions in million 2002 chained Canadian dollars.

Sources of the data used for the regression model:

Variable	Source
Housing stock	Statistics Canada and author's calculations (as describe above)
Household formation	CENSUS and author's calculations (as describe above)
Real disposable income per capita	Haver from Statistics Canada
Construction cost	Haver
Mortgage rate	Haver
House prices	CREA (average house prices)

III. Recent Experience with Macro-Prudential Tools in Canada: Effectiveness and Options Moving Forward[1]

A. Introduction

1. **Canada's household debt as a share of disposable income has surged over the last decade.** Since 2000, household debt has increased by about 60 percentage points, reaching a record high 163 percent of disposable income in mid-2012 a relatively high figure compared to other economies. To a large extent, this increase reflects robust growth in mortgages and home equity credit lines (HELOCs). Mortgage credit expanded on average by 8¾ percent yearly since 2000, outpacing the growth rate of disposable income (4½ percent) and supporting a significant increase in home-ownership rates. Consumer credit expanded at a similarly fast pace (mainly due to HELOCs), but slowed significantly after 2010. Mortgages and consumer loans secured by real estate (mostly HELOCs) are estimated to account for 80 percent of household debt and represent the single largest exposure for Canadian banks (about 35 percent of their assets).

2. **Falling interest rates, surging house prices, and financial innovations were key factors behind the credit surge**. Average 5-year mortgage rates fell from 8¼ percent in 2000 to 4¼ percent at present. With house prices almost doubling over the last ten years real estate assets now accounts for 40 percent of overall household assets, up from about 30 percent in 2000. Still, household leverage (debt over assets) has increased to a record high 20 percent, up by 5 percentage points from 2000, and is relatively high compared to other economies.[2] Financial innovations also played a role in the expansion of housing credit, including with respect to government-backed insured mortgages.[3]

3. **The Canadian authorities have taken several macro-prudential measures since 2008 to support the long-term stability of the housing and mortgage markets and prevent excessive household leverage.** While the financial sector is partially protected by government-backed mortgage insurance, a sudden sharp fall in housing prices could cause financial distress among households and have a material impact on the economy (Selected Issues, Chapter I). The authorities tried to cool the housing market and contain household leverage through a series of macro-prudential measures that unwound many of the measures taken in the early 2000s to support the mortgage market. Since 2008, there have been four rounds of tightening regulations on government-backed insured mortgage loans. Moreover,

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[1] Ivo Krznar and Paulo Medas.

[2] It averages about 15 percent in a sample of OECD economies (including the United States, Australia, the United Kingdom, and Germany).

[3] Mortgage insurance plays a big role in the Canadian mortgage market with around 60 percent of banks' residential mortgage loans insured.

these measures were accompanied by a strengthening of lending mortgage underwriting standards and enhancement to the oversight of CMHC (the major provider of mortgage insurance).

4. **This paper assesses the effectiveness of these measures and looks at possible lessons from the international experience on macro-prudential policy**. We assess whether the macro-prudential measures adopted in Canada since 2008 have been effective, by trying to isolate their impact from that of other variables that have a bearing on the housing market and mortgage credit. While household debt to income ratio continued to increase in 2012, house prices and mortgage credit growth have moderated at a national level since 2011, partly in response to the tighter conditions set by the Canadian authorities. Household leverage would be even higher if the authorities did not take action. International experience on macro-prudential measures confirms that they may be effective in curbing credit and house price growth, especially if taken in the context of higher interest rates. A lesson from this evidence is that reducing caps on the maximum loan to value (LTV) ratios may be one of the most effective instruments to reduce household leverage.

B. The Effectiveness of Recent Macro-Prudential Measures in Canada

Overview of the measures and its objectives

5. **Mortgage lending conditions relating to the provision of government-backed mortgage insurance were relaxed in the mid-2000s.** Financial innovation, on the part of mortgage insurers and lenders, ensured easy access to mortgage market and helped boost the housing sector. Measures included (Table 1): (i) broadening the eligible sources of funds for the minimum down payment; (ii) increasing the maximum LTV ratio that triggers mandatory insurance to 80 percent, and the maximum LTV ratio for any new government-backed insured loans to 100 percent; (iii) increasing the maximum amortization period from 25 to 40 years; and (iv) providing insurance on interest-only mortgages and on mortgages to self-employed. Together with sharply lower interest rates, these measures made mortgages more affordable, supporting the boom in mortgage credit and increasing home-ownership rates. In turn, higher house prices were one of the factors that led to a sharp expansion of home equity credit lines.

6. **As house prices and mortgage credit surged, the focus changed towards ensuring a more sustainable expansion of the housing market and containing households growing imbalances.** Since 2008, the federal government has undertaken four rounds of measures to tighten mortgage insurance, going beyond a reversal of the loosening in the mid-2000s (Table 2). Key measures included: reducing the maximum amortization periods to 25 years; imposing a 5 percent minimum down payment; introducing a maximum total debt service ratio of 44 percent; tightening LTV ratios on refinancing loans and on loans to purchase properties not occupied by the owner; and withdrawing government insurance backing on lines of credit secured by homes, including non-amortizing HELOCs.

7. **The latest round of measures (July 2012) was also accompanied by new *prudential* rules (that became effective only in late 2012) and efforts to strengthen the oversight of the mortgage insurance industry** (Table 3).

- Building on the FSB Principles for Sound Residential Mortgage Underwriting Practices and OSFI's review of mortgage lending practices in Canada, OSFI issued a Guideline for Residential Mortgage Underwriting Practices and Procedures in June 2012. The OSFI Guideline applies to all federally-regulated financial institutions engaged in residential mortgage underwriting and or the acquisition of residential mortgage loan assets in Canada. The Guideline outlines requirements under the following five principles: comprehensive board-approved residential mortgage underwriting policy (for example, self-employed stated income mortgages, without some verification of income, and cash-back down payments were disallowed); due diligence to record and assess borrower's identity, background, and willingness to service debts; adequate assessment of borrower's capacity to service debt obligations (reduce the maximum LTV ratio on HELOCs); sound collateral management and appraisal processes; and effective credit and counterparty risk management that supports mortgage underwriting and asset management, including mortgage insurance; and[4]

- Additional measures were introduced to strengthen the oversight of the mortgage insurance industry. The *Protection of Residential Mortgage or Hypothecary Insurance Act* (PRMHIA) was enacted, which formalizes the rules for government-backed mortgage insurance and other existing arrangements with private mortgage insurers. The authorities also introduced legislation to enhance the governance and oversight framework for CMHC, by mandating OSFI to examine CMHC's insurance and securitization businesses.[5] In addition, new legislation was announced that provides a robust framework for the issuance of covered bonds (e.g., high standards on disclosure) while at the same time prohibiting the use of government-backed insured mortgages as covered bond collateral. The later measure will likely make covered bonds a relatively more expensive source of funding for home loans.

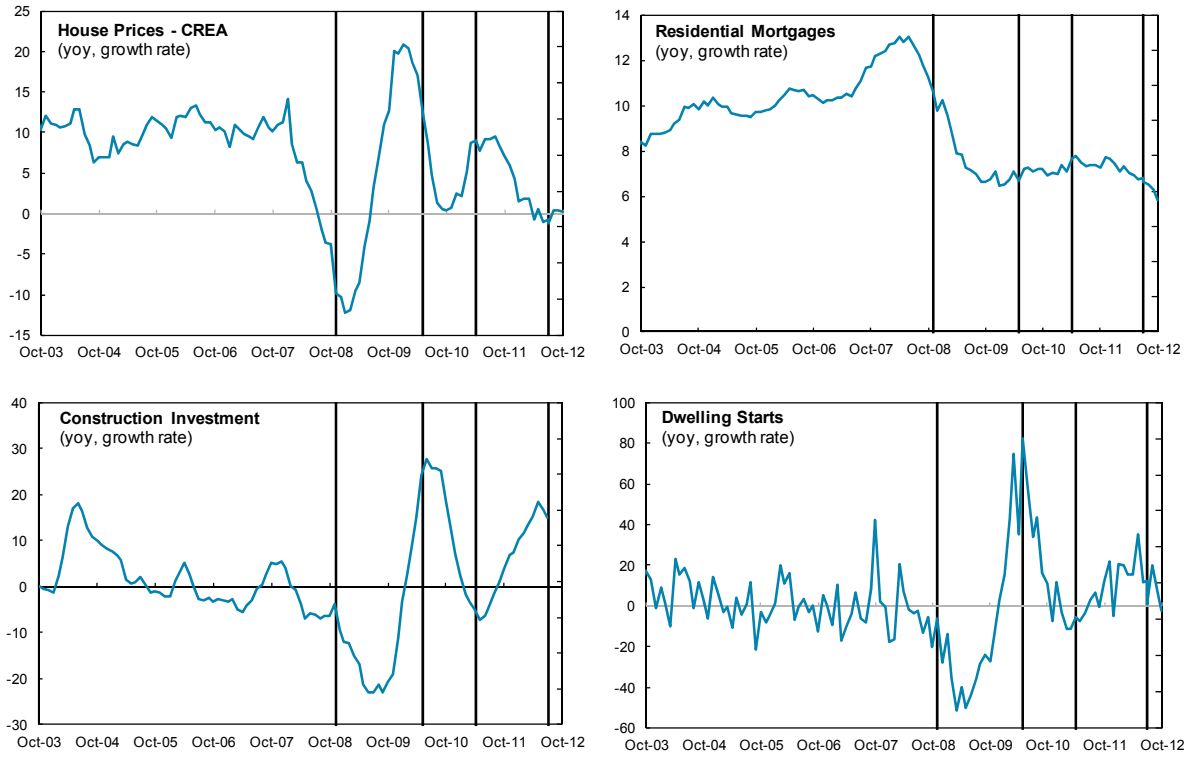
[4] OSFI expects federally regulated financial institutions to comply fully with the guideline by the end of fiscal year 2012.

[5] OSFI is required to undertake examinations or inquiries and report the results, including any recommendations, to the Corporation's Board of Directors and Ministers of HRSDC and Finance. CMHC's Corporate Plan must contain a proposal indicating how CMHC will respond to OSFI recommendations.

How effective were the macro-prudential measures?

8. ***Prima facie* evidence provides mixed results on the effectiveness of the measures adopted in 2008, 2010, and 2011 (Figure 1)**. Mortgage credit growth and house price growth fell considerably following the 2008 measures, but this largely reflects the impact of the international crisis as the housing market rebounded strongly a few months later, in line with Canada's fast recovery from the recession. House prices and mortgage credit growth decelerated following the policy changes adopted in 2010, but again most of the decrease was short lived. The 2011 measures seem to have contributed to the slowdown in house prices and residential investment. Nevertheless, household credit continued to grow at a stronger pace than household disposable income. The authorities implemented a new tightening round in July 2012, with the latest data suggesting mortgage credit is slowing and house prices continue to moderate.

Figure 1. Impact of First Three Rounds of Tightening of Macro-Prudential Measures



Sources: Haver Analytics, Canadian Mortgage and Housing Corporation, and Statistics Canada.

9. **But a proper assessment of the effectiveness of these measures requires controlling for the context in which they were taken**. Other factors may have been at play at the same time, diluting the effects of the measures on the housing market and household leverage. Moreover, while the measures may not have led to an observable significant slowdown in house prices and credit, they may have been successful in preventing an even

stronger increase. In order to control for other factors and have a better assessment of the effectiveness of the macro prudential measures, we estimate the equation:

$$Y_t = \alpha + \beta X_t + \gamma D^i{}_t + \varepsilon_t$$

where Y_t is mortgage credit or house price growth; X_t is a matrix of control variables (both current and lagged); and $D^i{}_t$ is a dummy variable equal to 1 in the months following the implementation of a set of measure *i* where *i* represents a specific set of measures (2008, 2010, 2011 and 2012) and zero otherwise (in the mortgage equation). To isolate the effects of individual rounds of measures, each dummy variable takes a value of 1 until the end of the sample. In other words, the effect of subsequent measures is estimated taking into account the existence of previous measures.[6] The mortgage credit equation includes the unemployment rate and hourly wage growth, 5-year mortgage interest rate, and house prices.[7] In the house price equation we include the number of completed houses, mortgage credit growth, GDP growth, and sales of existing houses.[8] We assess the impact of the first three rounds of measures using the entire sample, but also test the impact over 1, 3, 6, and 9 months after they were introduced, and for the whole period between rounds.[9] In some specifications, the dummy variable is replaced with changes in a specific instrument (e.g., maximum LTV ratio). We also assess the impact of the fourth round of measures, although with a still very limited sample.

10. **The results suggest that the measures introduced helped limit the increase in household leverage.**

- ***The first round of measures does not appear to have had an impact on mortgage credit growth***. The estimated coefficients for the 2008 measures are not statistically significant across the different specifications, and have the wrong sign in almost all specifications (Table 4). While credit growth did decelerate significantly in the 12 months following the measures this reflects the increase in unemployment and fall of household income in that period. The lack of effects could be partly related to the limited scope of the measures, as the maximum amortization period was still high and the effective LTV ratio still at 100 percent.[10] This was also a time when the

[6] The cumulative effect of measures is just the sum of coefficients in vector γ.

[7] This follows Crawford and Faruqui, (2012). The analysis is constrained by important data limitations. There is no publicly available disaggregated data on the different types of credit (especially those that were targeted by the measures). Therefore, the analysis focus on aggregated measures of mortgage credit.

[8] This follows Peterson and Zheng (2011). Igan and Kang (2011) also use similar specifications for Korea.

[9] To isolate the effect of the specific set of measures, we control for measures that were introduced before that specific set.

[10] The amortization period limit was set at 35 years whereas the average amortization period for CMHC insured loan was 25 years. While the share of new mortgages with 40-years amortization fell sharply following the

(continued)

authorities took measures to promote economic activity and make liquidity available to the financial system, including through the purchase of pools of insured mortgages.

- ***The evidence, on the other hand, suggests the last three rounds of measures dampened credit growth and household debt***. They had a statistically significant impact on mortgage credit growth, ranging from 1 (the 2010 measures) to about 2 percentage points (the 2012 measures) on average during the period when they were in force (Table 4, panel 1). All measures had an immediate impact on mortgage credit growth (Table 4, panel 2), but while the effect of the 2010 measures tapered off after 3 months, the impact of the 2011 and 2012 measures got stronger with time. The effectiveness of the 2010 measures reflected the focus on the LTV ratio on refinance loans, one of the main drivers of household debt;[11] the significant increase of the down payment on properties not occupied by owners; and the more stringent eligibility criteria introduced.[12] The measures taken in 2011 and 2012 have been more effective, as they came on top of the former tightening rounds.[13] Both rounds tightened further the LTV ratio on refinance loans and brought the maximum amortization period closer to the average, which likely prevented more borrowers from taking new loans (or reduced the size of the loans).[14] The new LTV ratio on refinance loans (down to 80 percent) could also be quite effective, as more than half of the new insured refinance loans in recent periods had a LTV ratio higher than 85 percent. Moreover, the new mortgage underwriting standards proposed by OSFI

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change in rules (from 32 percent to almost zero), Dunning (2009 and 2012) suggests that the vast majority of borrowers managed to substitute these with loans with 25–35 years. Even though the government set a minimum down payment of 5 percent for insured loans, "cash backs", unsecured borrowing and gifts could have been considered part of the down payment. OSFI's B-20 guideline from July 2012 stipulates that banks should make every effort to determine if down payment is sourced from the borrower's own resources or savings.

[11] Dunning (2011) shows that the share of new refinance mortgages with an LTV ratio of 90 percent or more fell from almost 50 percent to zero. However, many refinance mortgages with high LTV ratios were replaced by mortgages with LTV ratios between 85 and 90 percent.

[12] All borrowers were required to meet the standards for a 5-year fixed-rate mortgage, even if they choose a variable rate, shorter term mortgage. Dunning (2011) shows that following this change there was a large rise in the qualifying interest rate used for variable rate mortgages (30 percent of total new mortgages), implying that more potential borrowers were not able to qualify for variable rate mortgages.

[13] However, the evidence on the 2012 measures is only partial (based on the impact after only 3 months). The effects will be clearer once more data is available.

[14] CMHC (2011) suggests that the volume of refinance loans dropped by 22 percent following the 2011 measures. Dunning (2012) estimates that the 2011 measures would push debt-service ratios above the maximum limit for about 6 percent of the high LTV mortgages taken out during 2010. He also suggests that about 11 percent of the borrowers in 2011 would have not been able to access credit following the latest reduction of the maximum amortization period.

could curb mortgage credit further as they will reduce the effective LTV from 100 to 95 percent.[15]

- ***The results for individual measures suggest that tightening LTVs for new mortgages and for refinancing loans had the largest impact.*** The estimates indicate that a 1 pp reduction of the maximum LTV for new mortgages and for refinancing loans tends to reduce y/y credit growth by 0.4 percentage points (Table 6). Reducing the amortization period appears to have a more modest impact, but the effect seems to depend on the level of interest rates. In particular, with a mortgage rate of 4½ percent, reducing the amortization period by 5 years dampens credit growth by 0.45 pp. But with mortgage rates at around 8 percent (as in the early 2000s) the impact would be close to 0.8 pp.[16]

- ***While the household debt to income ratio continued to increase in 2012, it would have likely been even higher if the authorities did not take action***. We run a simple counterfactual exercise, and calculate the fitted regression values of mortgage growth rates both with the measures and without them. Assuming all else stays the same, without the measures the average monthly growth (y/y) of mortgage credit would have been 1 pp higher than actually observed since April 2010, while house price growth would have been on average higher by 1.2 pp (Table 5). The household debt-to-income ratio would have been closer to 170 percent as of Q3:2012, instead of the actual 165 percent.

Policy options based on international experience

11. **Countries have used a variety of policy tools to deal with house price and mortgage credit booms.** Studies on effectiveness of macroprudential measures show that a number of tools can reduce credit growth pro-cyclicality (Lim et al., 2011) and reduce the risk of a bust (Dell'Ariccia et al., 2012, CGFS, 2012). There is also some evidence that suggest that LTV caps can be an effective tool in dealing with credit and real estate booms.[17]

12. **In this section we look at international experience with a few major macro-prudential measures.** We focus on four measures: limits to loan to value ratios; caps to debt to income ratios; greater risk weights for banks' credit assets; and higher provisioning requirements for banks. To estimate the quantitative impact of these measures on total credit

[15] OSFI's B-20 guideline stipulated that banks should make reasonable efforts to determine if down payment is sourced from the borrower's own resources or savings. CMHC (2012) claims that 35 percent of households who purchased a house in 2011 were first-time borrowers and about 15 percent of them borrowed at least part of the down payment.

[16] Estimates of the isolated impact of changes in the amortization period were not statistically significant.

[17] See Almeida, Campello, and Liu (2005), Crowe et al. (2011), Wong et al. (2011), Ahuja and Nabar (2011), Igan and Kang (2011), and IMF (2011).

growth and house price growth we use panel data regressions across a sample of 25 countries which have introduced such measures over the 2000–2011 period.[18] A first set of regressions uses a "step function variable" for each macro-prudential instrument, that is, a variable that increases by one every time the instrument is tightened and stays there until the instrument is changed. A second set of regressions uses the actual LTV limits instead of the step function. We control for the business cycle and the cost of borrowing by including GDP growth and long-term lending rate as independent variables.

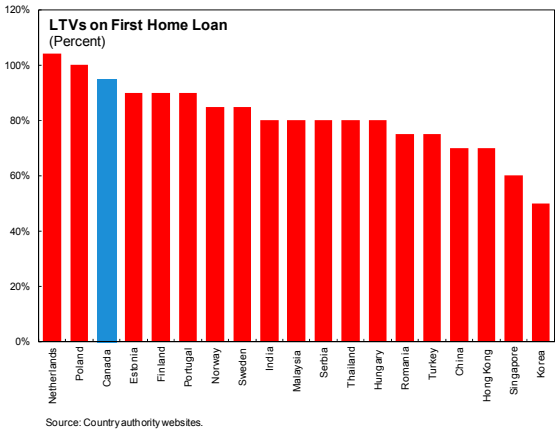
13. **The results suggest that LTV ratios, debt-to-income (DTI) ratios and risk weights can be effective in containing credit and house prices growth**.

- ***Tightening LTV ratios, DTI ratios, and risk weights lead to a reduction in credit growth***. During the period when these instruments are tightened, the quarterly credit growth rate is lower by about ½–¾ pps (on average during the period when they are tightened). By contrast, tighter provisioning requirements do not seem to have a significant impact on credit growth (Table 7, columns 1–4).

- ***LTV ratios and risk weights appear to have a significant effect on house price growth*** (Table 8). The significant impact from changes in risk weights is probably due to their direct impact on banks' balance sheet.

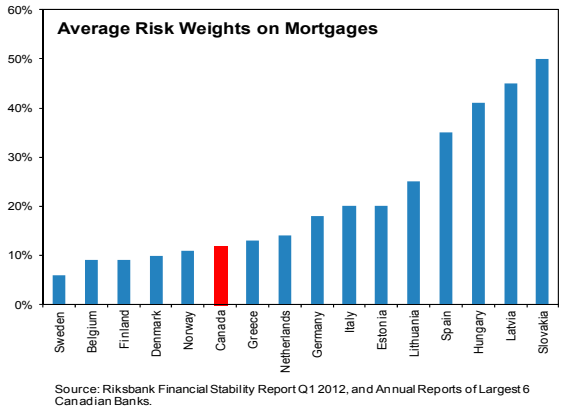
- ***Tightening LTV ratios on new mortgages tends to have an impact on credit growth similar to the one we estimated in Canada.*** A 10 pps reduction in LTV ratios would result in lower (total) credit by 1.3 percent (y/y) (Table 9). This is a similar to the impact we found for Canada (Table 6), where a reduction of 10 pps in first buyer LTV ratios would result in a fall of 4 percent in mortgage credit (y/y) on average during the period when it is applied (mortgage credit accounts for about 40 percent of total credit to private sector in Canada).

14. **In light of this evidence, and given the relatively generous LTV ratios, further tightening LTV ratios could be an effective response in Canada if household leverage continues to rise.** The average (maximum) LTV ratio on new mortgages in our sample of countries is around 80 percent, and only two countries have



[18] The data comes from Krznar and others (forthcoming) and the regressions from Arregui and others (forthcoming).

LTV ratios higher than Canada.[19] Canada has DTI limits in line with other countries. In addition, while average risk weights on mortgage are relatively low, this mainly reflects the prevalence of government-backed mortgage insurance in Canada (which have a zero risk weight if a mortgage loan is insured by CMHC). To be effective, increasing risk weights would likely need to be accompanied by some scaling back of government-backed insurance. Alternative options could be increasing risk weights on consumer loans secured by real estate (mainly HELOCs), which would increase the cost of the loans, help reduce overall household credit growth, and at the same time strengthen the resilience of the banking system.[20]



Source: Riksbank Financial Stability Report Q1 2012, and Annual Reports of Largest 6 Canadian Banks.

15. **Finally, there is some evidence that the effectiveness of macro-prudential measures would be reinforced by a rise in interest rates**. An interaction term between the instruments and the interest rates was introduced in the regressions to assess whether the effectiveness of the instruments depends on the levels of the interest rates. In particular, we would expect the measures to be less effective if interest rates are low, as more borrowers would be able to withstand the increase in borrowing costs. The results show that tightening LTV, DTIs, and risk weight will have a larger impact when interest rates are higher (Table 7, columns 5–8). This is consistent with the results on Canada's measures (in particular, the reduction of the maximum amortization period), as discussed above. The implication is that macro prudential measures are likely to be less effective under the present environment of very low interest rates. At the same time, this also implies that monetary policy would have a stronger effect once macro prudential measures have been tightened.

C. Conclusions

16. **The macro-prudential measures taken so far by the authorities have been somewhat effective, but more may need to be done if households financial imbalances continue to rise and the house prices and real estate activity were to accelerate**. These measures, especially the latest rounds, have curbed credit growth and moderated the spike in house price. But household debt continued to rise and house prices remain high (relative to rents and income) and overvalued according to staff estimates. In addition, although

[19] It is important to note that simply comparing LTVs can be misleading, as the appropriate or optimal level of mortgage LTV for each country will depend on a number of country-specific factors.

[20] Secured personal lines of credit, which are mostly backed by houses (i.e., home-equity lines of credit), have risen sharply both in absolute terms and as a share of total consumer credit. In 1990, secured PLCs represented less than 10 percent of consumer credit; in 2011 their share had risen to about 50 percent (Crawford and Faruqui, 2012).

mortgage credit growth has slowed significantly relative to pre-crisis levels, it continues to exceed disposable income growth, despite record high household debt. While it might be too early to assess the full impact of the measures taken in 2012, international experiences on macro prudential measures provides some insights for Canada. In particular, higher down payment requirement (tighter LTV limits for first-buyers), lower caps on the debt-to-income ratio and tighter LTV ratios on refinancing could all be effective options worth exploring if needed. Finally, the evidence suggests that the effectiveness of macro-prudential measures increases with the level of interest rates. As Staff expects interest rates in Canada to increase in 2013, this result implies that new changes to mortgage insurance and lending requirements should occur at a gradual and measured pace.

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Table 1. Mortgage Insurance Products Until 2008

2003	Genworth Financial broadened the eligible sources of funds for the minimum down payment, allowing it to be borrowed as opposed to coming from the borrowers' unencumbered funds
March 2004	CMHC "Flex Down" program broadened the eligible sources of funds for the minimum down payment (5%), allowing it to be borrowed as opposed to coming from the borrowers' unencumbered funds
March 2006	CMHC started to insure mortgage loans amortized up to 30 years (as a part of a pilot project) Genworth announces it will insure 30- and 35-year loans
June 2006	CMHC started to insure mortgage loans amortized up to 35 years; CMHC started to provide insurance on interest-only payments for up to the first 10 years of a mortgage loan (for borrowers with a proven history of managing their credit)
September 2006	Genworth announces it will offer insured 40-year mortgage (with the LTV ratio up to 100%) with interest-only payments for the first 10 years
December 2006	CMHC started to insure mortgage loans amortized up to 40 years; CMCH started to provide insurance on mortgage loans with the LTV ratio between 95% and 100% ("Flex 100", effective November 2006)
March 2007	CMHC started to insure mortgage loans to self-employed ("Self-Employed Simplified")
July 2007	LTV limit after which a loan has to be insured increased from 75 to 80 percent

Sources: CMHC, Genworth.

Table 2. Tightening Mortgage Insurance Regulations Since 2008

October 2008 (announced in July)	Maximum amortization for new government backed insured mortgages was set at 35 years
	Maximum LTV was reduced from 100 to 95 percent
	Credit score floor at 600 with some exceptions
	New loan documentation requirements
April 2010 (announced in February)	Maximum LTV for insured refinanced mortgages was lowered from 95 to 90 percent
	Minimum down payment on properties non-owner-occupied properties was raised from 5 to 20 percent
	More stringent eligibility criteria was introduced (all borrowers are required to meet the standards for a 5-year fixed-rate mortgage, even if they choose a mortgage with a variable interest rate and shorter term)
March/April 2011 (announced in January)	Maximum amortization for new government backed insured mortgages was lowered (from 35 to 30 years)
	Maximum LTV for refinanced mortgages was lowered (from 90% to 85%)
	Government-backed insurance on non-amortizing lines of credit secured by houses (HELOCs) withdrawn in April
July 2012 (announced in June)	Maximum amortization for new government backed insured mortgages was lowed (from 30 to 25 years)
	Maximum LTV for refinanced mortgages was lowered (from 85% to 80%)
	Maximum gross debt service and total debt service ratios were fixed at 39% and 44%, respectively
	Government-backed insured mortgages will now be available only on homes with a purchase price of less than $1 million

Sources: CMHC, Genworth.

Table 3. Microprudential Measures in Canada

Protection of Residential Mortgage Hypothecary Insurance Act and amendments to the National Housing Act (2011/2012)	Formalizes the rules for government-backed mortgage insurance and other existing arrangements with private mortgage insurers Provision for the Minister of Finance to charge fees to compensate the Government for its exposure to risk represented by mortgage insurance
The Jobs, Growth, and Long-term Prosperity Act (2012)	Canadian banks prohibited from issuing covered bonds backed by government-insured mortgages (sets strong eligibility criteria for mortgages in the cover pool) CMHC designated as administrator of the covered bond framework CMHC's mandate was enhanced to include financial stability as an objective of CMHC's commercial activities CMHC commercial activities subject to OSFI examination
Guideline on Sound Residential Mortgage Underwriting Practices (B-20) (2012)	A guideline for residential mortgage underwriting practices and procedures was issued by OSFI (including assessment of borrower's background and demonstrated willingness to service debt payment in a timely manner, assessment of borrower's capacity to service debt, assessment of property value/collateral, effective credit and counterparty risk management, comprehensive residential mortgage underwriting policy) Maximum LTV on HELOCs cut (from 80% to 65%) Stated Income mortgages are no longer allowed without some verification of income OSFI expects federally regulated financial institutions to comply fully with the guideline by the end of the fiscal year 2012/13

Sources: Department of Finance Canada, OSFI.

Table 4. Effects of Macroprudential Measures on Mortgage Credit

Dependent variable: Mortgage credit (Y/Y)	I
House prices (lagged)	0.06 ***
	0.02
Wages (lagged)	0.21
	0.22
Interest rate (lagged)	-2.01 ***
	0.16
Unemployment rate (lagged)	-2.16 ***
	0.19
2008 measures	-0.98
	0.75
2010 measures	-1.07 **
	0.52
2011 measures	-1.51 ***
	0.33
2012 measures	-1.88 ***
	0.41
Number of observations	172
R^2	0.80

Effectiveness of Measures	I	II	III	IV	V
2008 measures	0.95	1.03	1.09	1.05	-0.93
	0.91	*0.98*	*1.07*	*1.09*	*0.62*
2010 measures	-1.58 **	-1.65 **	-1.08 *	-0.98 *	-1.08 **
	0.77	*0.73*	*0.66*	*0.53*	*0.54*
2011 measures	-0.85 ***	-0.92 ***	-0.98 ***	-1.15 ***	-1.50 ***
	0.28	*0.25*	*0.24*	*0.27*	*0.33*
2012 measures	-1.48 ***	-1.77 ***			-1.88 ***
	0.26	*0.39*			*0.41*

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level. Standard deviations in italic.

2/ The estimation period is 1998:8–2012:11, using montly, seasonally adjusted data. Newey-West consistent variance estimator is used to calculate coefficients' standard deviation.

3/ Regressions I to IV estimate macroprudential measures effects after 1, 3, 6 and 9 months respectively after their implementation. Regression V estimates effects of each macroprudential measure between rounds of measures.

Table 5. Effects of Macroprudential Measures on House Prices

Dependent variable: House prices (Y/Y)	I
Mortgage credit (lagged)	1.19 ***
	0.18
Completed houses	-0.07 **
	0.03
Existing sales	0.3 ***
	0.03
GDP	0.56 ***
	0.22
Number of observations	169
R^2	0.67

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level. Standard deviations in italic.

2/ OLS estimation, period of 1998:8–2012:8. Monthly, seasonally adjusted data are used.

3/ Newey-West consistent variance estimator is used to calculate coefficients' standard deviation.

4/ The dependent variable is the y-o-y change in house price index (source: CREA).

Table 6. Effects of Specific Macroprudential Measures on Mortgage Growth—OLS Estimation (1998–12)

Dependent variable: Mortgage growth (y/y)	I	II	III	IV	V	VI	VII	VIII	IX
Amortization period	-0.13 **	0.09							
	0.05	*0.07*							
LTV on refinance loans	0.49 ***		0.36 ***						
	0.09		*0.06*						
LTV on first time borrowers	0.43 **			0.40 **					
	0.13			*0.15*					
Average LTV					1.18 ***				
					0.23				
LTV on refinance loans*Interest rate						0.07 ***			
						0.01			
LTV on first time borrowers*Interest rate							0.06 ***		
							0.02		
Average LTV*Interest rates								0.21 ***	
								0.04	
Amortization*Interest rate									0.02 **
									0.01
Number of observations	172	172	172	172	172	172	172	172	172
R^2	*0.83*	*0.7*	*0.78*	*0.71*	*0.81*	*0.78*	*0.73*	*0.81*	*0.72*

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level.

2/ The estimation period is 1998:8–2012:11, using montly seasonally adjusted data. Newey-West consistent variance estimator is used to calculate coefficients' standard deviation. Standard deviations in italic.

3/ All regressions include control variables as in Table 4 but are not shown here.

Table 7. Effects of Macroprudential Measures on Credit; Panel GMM Estimation (2000–11)

Dependent variable: Real Credit growth (deflated by CPI)	I	II	III	IV	V	VI	VII	VIII
Credit Growth Rate$_{t-1}$	0.58 ***	0.59 ***	0.55 ***	0.24 ***	0.59 ***	0.59 ***	0.54 ***	0.24 ***
	0.04	*0.04*	*0.03*	*0.03*	*0.04*	*0.04*	*0.03*	*0.02*
GDP Growth$_t$	0.18 ***	0.25 ***	0.19 ***	0.21 ***	0.19 ***	0.25 ***	0.18 ***	0.15 ***
	0.07	*0.1*	*0.06*	*0.08*	*0.07*	*0.10*	*0.06*	*0.08*
Lending rates$_t$	-0.1 ***	-0.03 ***	-0.07 ***	0.03	-0.10 ***	-0.01	-0.07 ***	-0.01
	0.02	*0.01*	*0.02*	*0.03*	*0.02*	*0.02*	*0.02*	*0.03*
Risk weights	-0.77 ***							
	0.18							
Provisioning		-0.23						
		0.24						
LTV			-0.46 ***					
			0.16					
DTI				-0.4 ***				
				0.14				
Risk weights*Interest rates					-0.05 ***			
					0.01			
Provisioning*Interest rates						-0.02		
						0.02		
LTV*Interest rates							-0.09 ***	
							0.02	
DTI*Interest rates								-0.09 ***
								0.01
Number of observations	670	578	750	401	670	578	750	401
Number of countries	15	13	17	9	15	13	17	9

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level. Standard deviations in italic.

2/ The estimation period is 2000:1–2011:4; quarterly, seasonally adjusted data. The sample is composed of 25 countries. The regression includes individual (country) effects. Time effects are not included because of high correlation with the macroprudential policy variable.

3/ A step function variable is used for all MaPP instruments (takes +1 at the time the instrument is tightened).

4/ Instrumental variables for the policy instrument (lags) and the (one-step) GMM Arellano-Bond estimator are used to address selection bias and endogeneity.

Table 8. Effects of Macroprudential Measures on House Prices—Panel GMM Estimation (2000–11)

Dependent variable: Real House prices (deflated by CPI)	I	II	III	IV	V	VI	VII	VIII
Real house price$_{t-1}$	0.44 ***	0.4 ***	0.39 ***	0.33 ***	0.44 ***	0.40 ***	0.39 ***	0.34 ***
	0.04	*0.04*	*0.04*	*0.05*	*0.04*	*0.04*	*0.04*	*0.05*
GDP Growth$_t$	0.41 ***	0.73 ***	0.47 ***	0.24 **	0.41 ***	0.73 ***	0.46 ***	0.24 *
	0.12	*0.14*	*0.1*	*0.13*	*0.12*	*0.14*	*0.10*	*0.13*
Lending rates$_t$	-0.08 *	-0.04 ***	-0.46 ***	-0.12	-0.07 *	-0.04	-0.45 ***	-0.11
	0.04	*0.02*	*0.09*	*0.09*	*0.04*	*0.03*	*0.09*	*0.09*
Risk weights	-0.6 ***							
	0.24							
Provisioning		-0.09						
		0.32						
LTV			-0.39 **					
			0.2					
DTI				-0.27				
				0.21				
Risk weights*Interest rates					-0.06 **			
					0.02			
Provisioning*Interest rates						0.00		
						0.03		
LTV*Interest rates							-0.06 ***	
							0.03	
DTI*Interest rates								-0.02
								0.02
Number of observations	464	458	635	328	464	458	635	328
Number of countries	12	11	15	8	12	11	15	8

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level. Standard e

2/ The estimation period is 2000:1–2011:4; quarterly, seasonally adjusted data. The sample is composed of 25 countries. The regression includes individual (country) effects. Time effects are not included because of high correlation with the macroprudential policy variable.

3/ Instrumental variables for the policy instrument and the (one-step) GMM Arellano-Bond estimator are used to address selection bias and endogeneity.

4/ Real house prices is defined as house price indices deflated by CPI (source: OECD, Global Property Guide, IMF dataset)

Table 9. Effects of Macroprudential Measures on Credit Growth—Panel GMM Estimation (2000–11)

Dependent variable: Real Credit growth (deflated by CPI)		
	I	II
Credit Growth Rate$_{t-1}$	0.54 ***	0.53 ***
	0.03	*0.03*
GDP Growth$_t$	0.18 ***	0.18 ***
	0.06	*0.06*
Lending rates$_t$	-0.08 ***	-0.53 ***
	0.03	*0.11*
LTV	0.03 ***	
	0.01	
LTV*Interest rates		0.004 ***
		0.001
Number of observations	750	750
Number of countries	17	17

1/ *,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level. Standard deviations in italic.

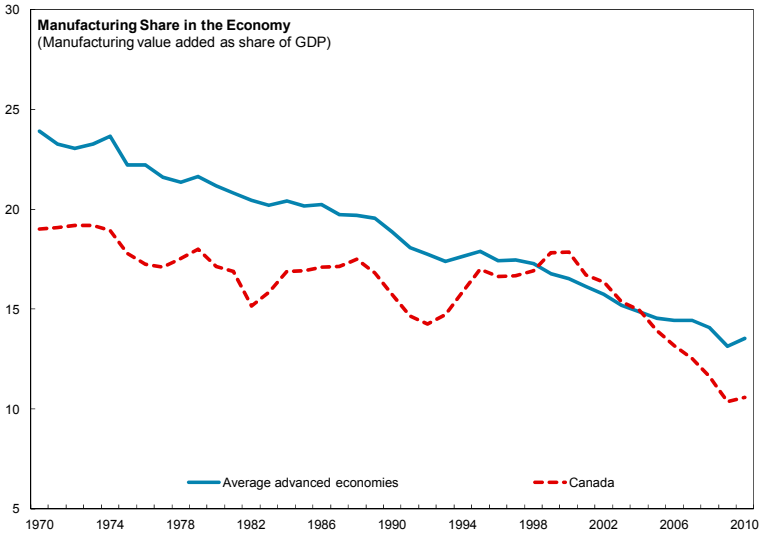
2/ The estimation period is 2000:1–2011:4; quarterly, seasonally adjusted data. The sample is composed of 25 countries.

3/ The regression includes individual (country) effects. Time effects are not included because of high correlation with the macroprudential policy variable.

IV. Canada's Loss of External Competitiveness: The Role of Commodity Prices and the Emergence of China[1]

A. Introduction

1. **Canadian merchandise exports have been on a roller coast over the last two decades, surging to 40 percent by end-2000 and falling to 24 percent of GDP in 2010.** Importantly, the composition of exports changed significantly as not all sectors were affected equally. The rise in exports in the 1990s was widespread, but the expansion in manufacturing was particularly impressive. After 2000, the fall in exports as a share of GDP was predominantly concentrated in manufacturing, while energy exports continued to expand and now represent about one fourth of all merchandise exports. While exporters benefited from a depreciation of the Canadian real effective exchange rate (REER) in the 1990s, commodity prices surged in the 2000s and were accompanied by a large appreciation of the REER. Higher commodity prices may well have an overall positive effect on the Canadian economy (see Carney, 2012).[2] But by driving the real exchange rate up, they may have also contributed to Canada's loss of external competitiveness and faster decline of its manufacturing share of value added over the last decade (chart). In this chapter, we focus on the factors behind Canada's loss of external competitiveness, and in particular we try to assess the role played by higher commodity prices and the emergence of China as a major trade power.



Sources: United Nations National Accounts.

2. **In recent years there has been a renewed interest in studying the links between commodity prices, the exchange rate, and manufacturing production in Canada.** Beine et al. (2009) estimate that about 40 percent of the manufacturing employment loss in Canada between 2002 and 2007 was due to the exchange rate appreciation. By contrast, Shakeri, Gray, and Leonard (2012) find some evidence that the exchange rate appreciation explains

[1] Prepared by Paulo Medas, based on forthcoming IMF Working Paper by Medas and Dai.

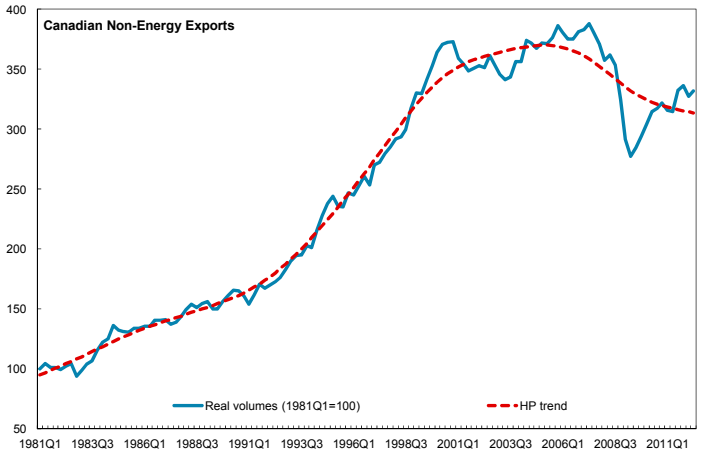
[2] Higher commodity prices have a direct positive welfare impact as they mean a transfer of wealth from the rest of the world, and thus higher income for Canadians. In addition, the domestic non-commodity economy benefits from higher demand for services and products from the commodity sector.

only a small part of the relatively weak manufacturing output performance. Governor Carney (2012) noted that only about half of the exchange rate appreciation over the past decade reflects the rise in commodity prices. Moreover, the decline of Canada's manufacturing share in the economy is a secular trend which is common to other advanced economies.[3]

3. **This paper assesses the causes of Canada's subpar export growth over the last decade and, in particular, the role played by commodity prices (via the exchange rate).**[4] This is particularly relevant not only because of the recent commodities boom, but also given that petroleum exports could more than double over the next decades. In addition, we focus on Canada's export share in the U.S. market, the destination for the vast majority of Canadian exports, and assess what factors have affected the ability of Canadian firms to compete in that market. Our objective is to assess how much of the decline in non-energy, and in particular manufacturing, exports can be related to the boom in commodity prices through their impact on the exchange rate and to the emergence of new powerful competitors such as China. The remainder of this paper is organized as follows. The next section provides an overview of the trade dynamics over the last decades. Section III examines the linkage between commodity prices and the exchange rate. Section IV investigates the extent to which the weaker Canadian exports to the U.S. reflect the stronger Canadian dollar and commodity prices. Section V, presents the conclusions.

B. Canadian Exports Dynamics Over the Past Decades

4. **After booming in the 1990s, Canadian exports weakened considerably over the last decade**. During the nineties, export volumes expanded at a robust pace of an annual average of 8½ percent boosted by robust U.S. demand. The free trade agreements with the U.S. (CUFTA in 1989 and NAFTA in 1994), also likely helped to preserve Canada's position as the leading exporter to its southern neighbor throughout the 1990s (Romalis, 2005). However, the export performance deteriorated markedly after 2000, with export growth stagnating up to 2007 and contracting sharply during the time of the financial crisis in 2008–09. Non-energy exports (chart above)

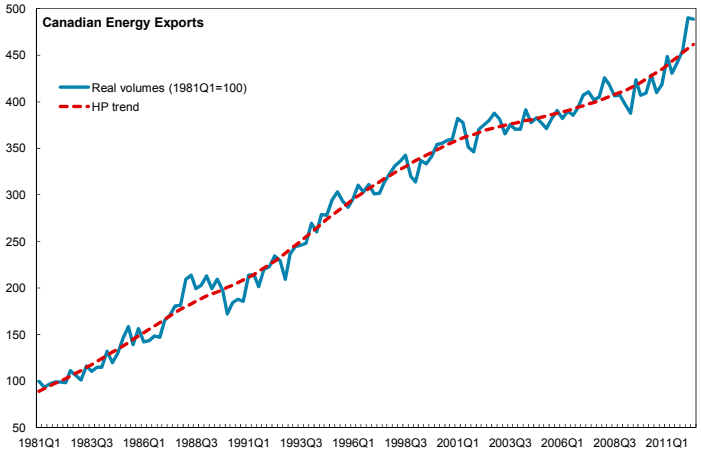


Source: Haver Analytics and Fund staff estimates.

[3] Governor Carney's speech on September 7, 2012.

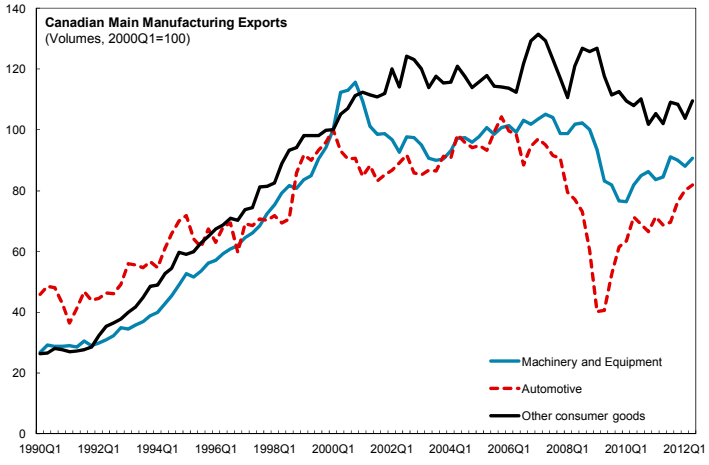
[4] In the paper we are focusing on non-renewable commodities that are tradable internationally, as such when we refer to commodities we focus on energy and metals.

have been affected the most, remaining below their 2000 volume levels at the end of 2011; whilst energy exports have continued to expand (chart below).



Source: Haver Analytics and authors' estimates.

5. **Manufacturing exports have been among the most hit, while the share of commodity exports has surged.** The decline in manufacturing exports explains close to 85 percent of the decline in overall merchandise exports as share of GDP in the 2000s.[5] Two major Canadian export sectors—automotive and machinery and equipment—have never fully recovered from the U.S. recession in 2001 (reflecting in part persistently weaker U.S. demand over the last decade). In particular, exports stagnated until 2006–07, and suffered another adverse shock during the 2008–09 global crisis (chart). The forestry industry has also experienced a collapse, reflecting the crisis in the U.S. housing sector, and its export volumes remain 35 percent below 2000 levels. By contrast, commodity exports have continued to expand and now represent about 40 percent of total merchandise exports, twice as large as in early 2000s. Energy exports, in particular, are up 25 percent during the same period and the energy trade balance has risen to a surplus of around 3¼ percent of GDP, compensating the sharp increase in the non-energy trade deficit (3¼ percent of GDP).

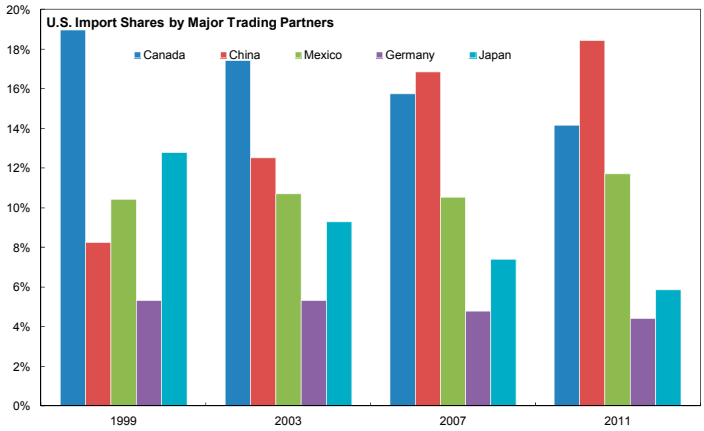


Source: Haver Analytics.

[5] In this section, manufacturing is broadly defined as including machinery and equipment, transportation, and other consumer goods (from Canada Statistics).

6. **The development in the U.S. markets has played a key role in the change of fortune for Canadian exporters.** The U.S. is by far the largest destination for Canadian products, absorbing more than ¾ of Canadian exports in the past decades. As such, a weakening U.S. demand is part of the explanation for the challenges faced by Canadian exporters in recent years (see also de Munnik et al., 2012). In particular, the growth of U.S. import volumes decelerated from around 10 percent a year in the 1990s to 4½ percent annually during the period of 2000–07. Over the same period, Canadian average yearly non-energy export growth also fell to a meager 1½ percent. During more recent years, Canadian exporters were also affected by the international crisis in 2008–09, further exacerbating the loss in external markets—non-energy export volumes in 2011 remained 12 percent below 2000 levels.

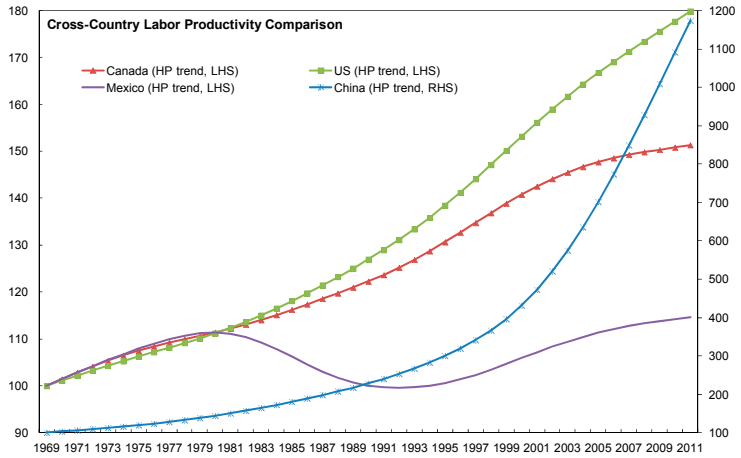
7. **Canadian firms also faced a significant loss of market share in U.S. markets.** Between 1999 and 2011, Canada's market share declined by 5 percentage points to 14⅓ percent of total U.S. imports, a loss equivalent to 6¼ percent of Canada's GDP. Over the same period, China overtook Canada to become the main exporter to the U.S. (chart). The case of manufacturing exports is particularly striking: while Canadian exports accounted for 20 percent of the total U.S. imports of machinery and transport equipment in1999, the share fell to 10½ percent by 2011.[6] In comparison, China's market share in machinery and transport equipment during the same period surged by 10 percentage points to 25½ percent.



Source: Haver Analytics.

8. **In the next sections we investigate what has driven Canada's declining external competitiveness.** A potential explanation is the impact of the sharp rise in commodity prices, which likely fuelled the substantial appreciation of the Canadian exchange rate hurting manufacturing exports. This effect is likely to be more important after 2000 given the rising volumes and prices of energy exports (in addition to metals). Other possible factors include the increasing productivity gap relative to key competitors (see chart below), and tighter competition from emerging economies (e.g., the emergence of China as a world exporter).

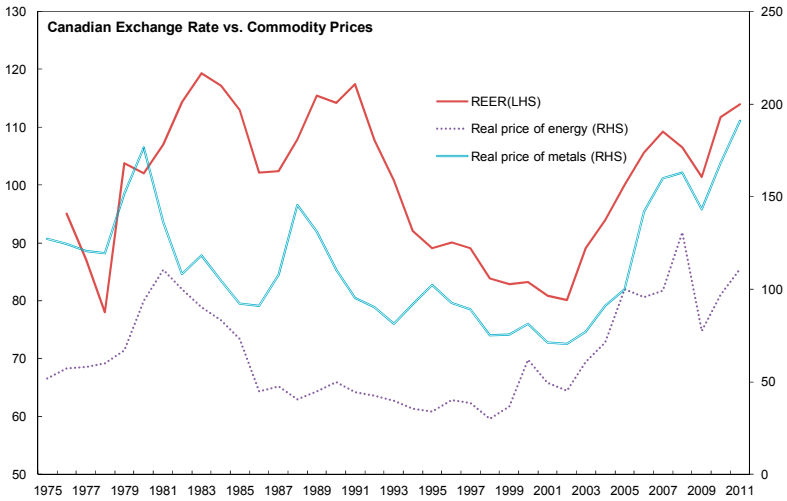
[6] As a consequence, while machinery and transport equipment accounted for close to half of Canadian exports to the U.S. in 1999, by 2011 they represented just slightly more than ⅓.



Source: Conference Board.

C. The Exchange Rate and Commodity Prices

9. **This section discusses the sensitivity of the Canadian exchange rate to commodity prices.** In particular, we examine the long-term relationship between the Canadian exchange rate and commodity prices. The Canadian real effective exchange rate (REER) seems to be highly correlated with the movements of metal and energy real prices, with the degree of correlation spiking over the last decade (chart). A seminal paper by Amano and van Norden (1995) suggests that there was a *negative* relationship between energy prices and the relative strength of the Canadian dollar over the period of 1973–1993.[7] However, more recent papers argue that this negative relationship has reversed over the past decade or so. For instance, Issa, Lafrance, and Murray (2008) find a *positive* relationship between the price of energy and the exchange rate from the 1990s onwards. The Bank of Canada argues that the rise in commodity prices accounted for about one half of the



Sources: IMF, Bank of Canada, Haver Analytics.

[7] By "negative", we mean that a rise in energy prices leads to a depreciation of the Canadian dollar versus the U.S. dollar.

appreciation vis-à-vis the U.S. dollar over the past decade, while about 40 percent is due to the multilateral depreciation of the U.S. dollar (Carney, 2012).

10. **Our analysis confirms a positive long-run relationship between the Canadian REER and both the energy and metal prices.** We test for a long-run equilibrium relationship between the real effective exchange rate and the commodity prices, using a vector error-correction model (ECM) of Canada's REER:

$$\Delta REER_t = \alpha\left(REER_{t-1} - \beta_1 P_{energy_{t-1}} - \beta_2 P_{metals_{t-1}} - \beta_3 Productivity_{t-1}\right) + \gamma_1 \Delta REER_{t-1} + \gamma_2 \Delta P\_energy_{t-1} + \gamma_3 \Delta P\_metals_{t-1} + \gamma_4 \Delta Productivity_{t-1} + \gamma_5 spread_{t-4}$$

where $\Delta REER$, ΔP_energy, ΔP_metals, and $\Delta Productivity$ are the first differences of the Canadian real effective exchange rate, real energy prices, real metal prices, and an index of Canada-U.S. productivity differential, respectively. The terms in the bracket are the co-integrating equation, measuring the deviation of the system from its long-run equilibrium relationship. The coefficient α is the error-correction parameter, which measures the adjustment speed towards the long-run equilibrium. The *spread* variable is the Canada–U.S. interest rate spread (see Appendix for description of the data). This regression also includes Canada's productivity gap with the U.S. Consistent with the Harrod-Balassa-Samuelson hypothesis, it is expected that the opening up of such a gap would exert downward pressures on the Canada's REER. The results are as follows:

- ***The surge in commodity prices (energy and metals) in the 2000–2007 is estimated to have led to an appreciation of the REER by about 25 percent, about three quarters of the total appreciation observed in the period.***[8] The estimated long-run impacts suggest that a 1 percent increase in the price of energy will lead to around 0.11–0.16 percent appreciation of the Canadian REER, whilst a 1 percent rise in the price of metals will result in a 0.4–0.5 percent appreciation (Table 1).[9] As real energy prices grew by 60 percent between 2000 and 2007, this factor alone might have caused the REER to appreciate by almost 10 percent over this period. While significant, such estimates are somewhat lower than in the recent literature.[10] We also test the relationship between the exchange rate and a composite commodity price

[8] These results are not fully comparable with those found by the Bank of Canada and referred above as the Bank's study looks at the bilateral rate with the U.S. dollar and at a wider set of commodity prices, including energy and non-energy (metals, forestry, fish, and agriculture) prices.

[9] Given our interest is in the long-term relationship, Table 1 only shows the estimates for the cointegrated equation (we omitted the constant in the table).

[10] Shakeri, Gray, and Leonard (2012) argue that for the post-2004 period, the exchange rate become more sensitive to commodity prices. They find that a 1 percent increase in energy prices would lead to an appreciation of 0.5 percent (and 0.7 percent for non-energy commodities).

index (a weighted average of metals and energy prices). A 1 percent increase in commodity prices would result in a 0.4 percent appreciation of the REER, although the impact would be somewhat lower if including the financial crisis in the sample period (Table 1, column V). Given that the composite commodity price index rose by 62 percent between 2000 and 2007, the expected appreciation would be close to 25 percent.[11]

- ***There is also some partial evidence of a long-run impact of the productivity gap on the exchange rate***. However, the estimated impact is relatively small and is not robust across samples. In particular, the productivity gap vis-à-vis the U.S. would have implied a depreciation of Canada's REER by ½ percent between 2000 and 2007. The impact of the commodity prices however dominated, and led to a substantial appreciation in the Canadian dollar.

D. What Explains Canada's Loss of Market Shares in the U.S.?

Methodology and data

11. **In this section, we assess the main factors behind Canada's loss of market share in the US**. The focus is on movements of the exchange rate (and commodity prices) and the emergence of China in international trade. We look at market shares, rather than exports volumes, to control for changes in the U.S. demand that affect all exporters. To better identify their impact on Canadian firms' competitiveness, and quantify which sectors have been the most affected, we look at imports to the U.S. markets using 4-digit levels (SITC) data over 1975–2010. The sector-level trade data also allows us to identify not only the overall effect on Canadian exports, but also which specific sectors are more exposed to the movements in the exchange rate (or commodity prices) and/or competition from China.

Our empirical specification is as follows:

$$CAN_{i,t} = \alpha_i + \beta_1 REER_t + \beta_2 CHN_{i,t} + \beta_3 X_t$$

Where $CAN_{i,t}$ represents the Canadian share of U.S. imports of good *i* at time *t*, while $REER_t$ is the Canadian real effective exchange rate, and $CHN_{i,t}$ is the Chinese share of U.S. imports of good *i* at time t. *X* is a vector of control variables, including Canadian domestic demand, U.S. GDP growth, and the dummies for the introduction of CUFTA/NAFTA (in

[11] Using higher frequency data, after controlling for market volatility (as measured by the VIX), does not change the main results (Table 1, columns VI and VII). Periods of high market volatility (as measured by the VIX index) may also be associated with large fluctuations in commodity prices, which potentially affect the estimates of the REER's sensitivity to commodity prices.

some specifications, when statistically significant, we used lags of independent variables).[12] A significant negative relationship between the appreciation and the market share in sector i would be evidence in support of a negative effect of the rise in commodity prices on Canada's market share, given that commodity prices have been the key driver of the movements in the Canadian exchange rate. However, it does not necessarily imply that the higher commodity prices have an overall negative impact on Canada as discussed above. For some regressions we explicitly include commodity prices as an instrument for the exchange rate. The inclusion of China's share as an independent variable controls for the effect of China's emergence as a large player in international trade over the last decades. The dynamic panel analysis is based on GMM estimators suggested by Arellano and Bond (1991).[13]

Results

12. **The REER appreciation and the emergence of China had a significant impact on Canada's non-energy U.S. market share.**

- ***A 10 percent appreciation of the REER reduces Canada's non-energy U.S. market share by about 0.6 percentage points on average between 1975 and 2007*** (Table 2). The estimated impact is somewhat larger when the regressions include commodity (energy and metals) or energy prices as instrument variables for the REER. This suggests that the rise in commodity prices was key in driving the loss of market share associated with the exchange rate appreciation. The results for the larger sample (1975–2010) show an even stronger impact of movements in the exchange rate on Canada's market share (Table 2b)—a 10 percent appreciation would lead to 0.8–0.9 percentage point fall in the market share.

- ***The competition effect from China is also significant***. Canada's non-energy U.S. market share falls by an estimated 13 basis points for every 1 percentage point increase in China's share (Table 2). Regressions for the different import groups show that the impact of China varies considerably, and is statistically significant on for those import groups where both countries compete.[14] The results suggest that the

[12] CUFTA is a free-trade agreement (FTA) between Canada and the United States, entered in 1989. NAFTA, replaced CUFTA since 1994, is a free-trade agreement (FTA) among Canada, the United States, and Mexico.

[13] The forthcoming Working paper discusses in more detail the regressions and robustness tests.

[14] For example, the impact of China seems to be stronger in some areas of manufacturing; while on commodities, beverages, animal products we could not find statistically significant impact as there is limited competition from China.

emergence of China in international trade had a significant impact (in some sectors) that is not being captured by movements in the exchange rate.[15]

13. **The evidence points to an even stronger impact of the exchange rate on Canada's manufacturing U.S. market share (Table 3).**

- ***In particular, a 10 percent increase in the REER results in 0.9 percentage point decline in Canada's manufacturing U.S. market share*** (columns III and IV). Accordingly, about 2.9 of the 4½ percentage points decline in Canada's manufacturing U.S. market share between 1999 and 2007 is likely attributed to the REER appreciation over that period. Adding commodity prices as an instrumental variable in the regressions points to a stronger impact of exchange rate movements (columns V and VI)—suggesting that, the appreciation of the exchange rate linked to the rise in energy and metal prices contributed to the loss of competiveness. The larger sample (1975–2010) again shows an even larger impact of the exchange rate and commodity prices on Canada's market share—a 10 percent appreciation would lead to a 1½ percentage point fall in Canada's market share (Table 3b). Applying the elasticity to the 2000–2011 period, the appreciation would explain almost 60 percent of Canada's loss.

- ***The REER appreciation did have a material negative effect on Canadian manufacturing exports.*** A simple counter-factual simulation shows that if the REER had stayed constant between 2000 and 2007, Canada's manufacturing share in the U.S. market would have been about 16 percent in 2007, rather than the actual 13 percent. Export growth would have been about 2¼ percentage points stronger every year between 1999 and 2007 and manufacturing exports would have been about 2½ percent of GDP higher in 2007.

- ***The rise of China as a major trade player also had a negative impact on Canada's market share.*** The results (Table 2, columns III to VI) indicate that a 1 percentage point increase in China's market share led to a decline of about 13 basis points in Canada's market share. While the elasticity may appear relatively small, the impact on Canada was significant, given the large rise in China's share over the last decades. In particular, based on the estimated elasticity, the increase of China's market share in the U.S. explain the 1.9 percentage points decline of Canada's share (about 40 percent total loss).[16] The 1975–2010 sample shows a somewhat larger elasticity (Table 7), but

[15] Namely, the regressions captured the effect of changes in the REER (or relative prices), but do not capture the effect from a new entrant in the market that has a significant relatively lower price level (as China). By including China's share we control for that effect.

[16] We tested whether this result reflects Canada and China's shares reacting to a common shock by introducing instrument variables for China's share (the productivity lag between Canada and China and China productivity

(continued)

the China's effect would explain a similar 40 percent of Canada's loss of market share in the 2000–2011 period.[17]

E. Conclusions

14. **Canada's waning export performance over the last decade reflects to a great extent the high dependence on the U.S. markets, the appreciation of its exchange rate, and a competitive disadvantage vis-à-vis China.** The weaker demand from the U.S. over the last decade played a role in the challenges faced by Canadian exporters. At the same time, Canada suffered a stark decline in its market share in the US. The large exchange rate appreciation between 1999 and 2011, driven by the surge in commodity prices, explains close to 60 percent of the fall in Canada's market share of U.S. manufacturing imports in the same period.[18] The increased presence of China as a competitor in the U.S. market explains around 40 percent of the loss. Canada's response to the new competitive challenges from China and stronger currency has been hindered by the lackluster growth of productivity.

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growth). In both cases, the estimated impact of China remains statistically significant and is even larger (columns VII and VIII)

[17] The control variables tend to have the expected sign. The introduction of CUFTA/NAFTA had a statistically significant positive (although small) impact on Canada's market share in most regressions. The domestic demand in Canada also tends to affect negatively exports to the US, possibly due to a substitution effect.

[18] In the 1999–2007 period, the appreciation explained slightly more than 60 percent of the market share loss, while China explained slightly more than 40 percent. Other factors (like CUFTA/NAFTA) had a smaller positive impact, only marginally compensating for the appreciation and China emergence.

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Table 1. Exchange Rate and Commodity Prices (Vector error-correction model)

Dependent variable: Real effective exchange rate (CPI based)	I	II	III	IV	V	VI	VII
Cointegrating equation							
price of energy	-0.110 ***	-0.141 ***	-0.167 ***				
t-statistic	[-2.37]	[-4.93]	[-5.37]				
price of metals	-0.370 ***	-0.490 ***	-0.378 ***				
t-statistic	[-4.77]	[-9.27]	[-7.46621]				
composite commodity price				-0.388 ***	-0.329 ***	-0.369 ***	-0.278 ***
t-statistic				[-4.65]	[-4.62]	[-4.06]	[-4.09]
Canada-US productivity gap		-0.390	-0.985 ***				
t-statistic		[-1.24]	[-3.69]				
VIX index						-0.180 *	-0.157 *
t-statistic						[-1.74]	[-1.77]
error-correction parameter	-0.116 ***	-0.178 ***	-0.141 ***	-0.064 ***	-0.067 ***	-0.030 ***	-0.030 ***
t-statistic	[-4.70]	[-5.92]	[-3.82]	[-3.56]	[-3.18]	[-3.48]	[-3.28]
interest rate spread (1 year)	0.004 ***	0.004 ***	0.003 *	0.003 **	0.004 **	0.001 **	0.001 **
t-statistic	[2.92]	[3.00]	[1.72]	[2.05]	[2.24]	[2.10]	[1.99]
number of observations	112	105	122	112	129	210	263
sample period	1980Q1-2007Q4	1981Q4-2007Q4	1981Q4-2012Q1	1980Q2-2007Q4	1980Q1-2012Q1	1990M7-2007M12	1990M7-2012M5

*,**,*** indicate respectively statistical significance at the 10, 5, and 1% level.

Note: All variables are expressed in logarithms except for interest rate spread, which is the Canada-US 3-month interest rate spread (4 lags). Regressions I to V are based on quarterly data, while VI and VII are using monthly data.

Table 2. Canada Shares in the US Non-Energy Import Market (1975–07)

Dependent variable: Canada share of US non-energy imports	I	II	III
real effective exchange rate	-0.064 ***	-0.074 ***	-0.075 ***
p-value	0.000	0.000	0.000
China share (contemporaneous and lag)	-0.135 ***	-0.132 ***	-0.133 ***
p-value	0.000	0.000	0.000
Canada domestic demand growth (lagged)	-0.002 ***	-0.002 ***	-0.002 ***
p-value	0.000	0.000	0.000
dum_CUFTA/NAFTA	0.015 **	0.015 **	0.015 **
p-value	0.020	0.025	0.025
A-B test in AR(1) in 1st difference	0.000	0.000	0.000
A-B test in AR(2) in 1st difference	0.272	0.279	0.280
Hansen test of overid. restrictions	0.234	0.305	0.303
Number of observations	11374	11374	11374
Number of instruments	477	477	477
Number of groups	525	525	525

*,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level.

The dependent variable is the Canadian share of U.S. imports in the non-energy sector (as defined in the appendix). The independent variables are the log of the contemporaneous Canadian real effective exchange rate (REER), the China share of US imports of manufacturing (comtemporaneous and lag), the lagged Candian domestic demand growth, the lagged US GDP growth and a dummy for CUFTA/NAFTA (takes value 1 for years under CUFTA or NAFTA and zero otherwise). In regression II, the log of commodities prices is used as an instrument for the REER; in regression III, the log of energy price is used as an instrument for the REER.

The table presents the long-term elasticities. The standard errors used to test level of significance of the long-term coefficients are based on the delta method.

Table 2b. Canada Shares in the US Non-Energy Import Market (1975–10)

Dependent variable: Canada share of US non-energy imports	I	II	III
real effective exchange rate	-0.077 ***	-0.089 ***	-0.090 ***
p-value	0.000	0.000	0.000
China share (contemporaneous and lag)	-0.176 ***	-0.170 ***	-0.170 ***
p-value	0.000	0.000	0.000
Canada domestic demand growth (lagged)	0.000	0.000	0.000
p-value	0.522	0.413	0.383
dum_CUFTA/NAFTA	0.019 ***	0.018 ***	0.018 ***
p-value	0.007	0.009	0.010
A-B test in AR(1) in 1st difference	0.000	0.000	0.000
A-B test in AR(2) in 1st difference	0.110	0.113	0.113
Hansen test of overid. restrictions	0.455	0.474	0.470
Number of observations	12831	12831	12831
Number of instruments	522	522	522
Number of groups	529	529	529

*,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level.

The dependent variable is the Canadian share of U.S. imports in the non-energy sector. The independent variables are the log of the contemporaneous Canadian real effective exchange rate (REER), the China share of US imports of manufacturing (comtemporaneous and lag), the lagged Candian domestic demand growth, the lagged US GDP growth and a dummy for CUFTA/NAFTA (takes value 1 for years under CUFTA or NAFTA and zero otherwise). In regression II, the log of commodities prices is used as an instrument for the REER; in regression III, the log of energy price is used as an instrument for the REER.

The table presents the long-term elasticities. The standard errors used to test level of significance of the long-term coefficients are based on the delta method.

Table 3. Canada Shares in the US Manufacturing Import Market - Panel GMM (1975–07)

Dependent variable: Canada share of US manufacturing imports	I	II	III	IV	V	VI	VII	VIII
real effective exchange rate	-0.062 **	-0.086 ***	-0.092 ***	-0.093 ***	-0.106 ***	-0.108 ***	-0.073 ***	-0.084 ***
p-value	0.014	0.005	0.000	0.000	0.000	0.000	0.001	0.000
China share (contemporaneous and lag)			-0.134 ***	-0.138 ***	-0.132 ***	-0.132 ***	-0.264 ***	-0.178 **
p-value			0.001	0.001	0.001	0.001	0.001	0.011
Canada domestic demand growth (lagged)	-0.004 ***	-0.004 ***	-0.003 ***	-0.003 ***	-0.003 ***	-0.003 ***	-0.002 **	-0.002 ***
p-value	0.000	0.000	0.000	0.004	0.000	0.000	0.012	0.007
US GDP growth (lagged)				-0.045				
p-value				0.59				
CUFTA/NAFTA	-0.046 **	-0.047 **	0.027 ***	0.027 ***	0.026 ***	0.026 ***	0.044 ***	0.045 ***
p-value	0.027	0.022	0.002	0.002	0.002	0.002	0.000	0.0003
A-B test in AR(1) in 1st difference	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A-B test in AR(2) in 1st difference	0.353	0.348	0.448	0.444	0.456	0.457	0.445	0.353
Hansen test of overid. restrictions	0.434	0.432	0.372	0.386	0.392	0.409	0.465	0.261
Number of observations	9300	9300	7010	7010	7010	7010	7010	7010
Number of instruments	308	308	291	292	291	291	282	282
Number of groups	309	309	299	299	299	299	299	299

*,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level.

The dependent variable is the Canadian share of U.S. imports in the manufacturing sector (as defined in the appendix). The independent variables are the log of the contemporaneous Canadian real effective exchange rate (REER), the China share of US imports of manufacturing (comtemporaneous and lag), the lagged Candian domestic demand growth, the lagged US GDP growth and a dummy for CUFTA/NAFTA (takes value 1 for years under CUFTA or NAFTA and zero otherwise). In regression II and V, the log of commodities prices is used as an instrument for the REER; in regression VI, the log of energy price is used as an instrument for the REER; in regression VII, the log of the productivity differential between Canada and China is used as an instrument for China's impact; in regression VIII, the log of Chinese productivity is used as an instrument variable for China's impact.

The table presents the long-term elasticities. The standard errors used to test level of significance of the long-term coefficients are based on the delta method.

Table 3b. Canada Shares in the US Manufacturing Import Market - Panel GMM (1975–10)

Dependent variable: Canada share of US manufacturing imports

	I	II	III	IV	V	VI	VII	VIII
real effective exchange rate	-0.099 ***	-0.131 ***	-0.114 ***	-0.114 ***	-0.132 ***	-0.135 ***	-0.101 ***	-0.115 ***
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
China share (contemporaneous and lag)			-0.178 ***	-0.171 ***	-0.170 ***	-0.168 ***	-0.354 ***	-0.261 ***
p-value			0.000	0.000	0.000	0.000	0.000	0.000
Canada domestic demand growth (lagged)	-0.002 **	-0.003 ***	-0.001 *	-0.002	-0.001 *	-0.002 *	-0.002 **	-0.002 *
p-value	0.021	0.009	0.101	0.111	0.069	0.053	0.018	0.052
US GDP growth (lagged)				0.063				
p-value				0.532				
CUFTA/NAFTA	-0.051 **	-0.052 **	0.039 ***	0.039 ***	0.037 ***	0.037 ***	0.050 ***	0.054 ***
p-value	0.016	0.012	0.000	0.001	0.001	0.001	0.000	0.000
A-B test in AR(1) in 1st difference	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A-B test in AR(2) in 1st difference	0.405	0.400	0.414	0.418	0.419	0.419	0.371	0.372
Hansen test of overid. restrictions	0.447	0.421	0.108	0.116	0.207	0.219	0.195	0.196
Number of observations	10189	10189	7878	7878	7878	7878	7878	7878
Number of instruments	308	308	248	249	248	248	278	278
Number of groups	309	309	299	299	299	299	299	299

*,**,*** indicate respectively statistical significance at the 10, 5, and 1 percent level.

The dependent variable is the Canadian share of U.S. imports in the manufacturing sector (as defined in the appendix). The independent variables are the log of the contemporaneous Canadian real effective exchange rate (REER), the China share of US imports of manufacturing (comtemporaneous and lag), the lagged Candian domestic demand growth, the lagged US GDP growth and a dummy for CUFTA/NAFTA (takes value 1 for years under CUFTA or NAFTA and zero otherwise). In regression II and V, the log of commodities prices is used as an instrument for the REER; in regression VI, the log of energy price is used as an instrument for the REER; in regression VII, the log of the productivity differential between Canada and China is used as an instrument for China's impact; in regression VIII, the log of Chinese productivity is used as an instrument variable for China's impact.

The table presents the long-term elasticities. The standard errors used to test level of significance of the long-term coefficients are based on the delta method.

APPENDIX I. DATA RESOURCES

A1. Time-Series Data (annual, quarterly, and monthly)

Real effective exchange rate (REER) based on CPI, computed by the IMF.

Commodity price index: the energy price index and metals price index are from the Bank of Canada, with weights for price index from Canadian trade data. We deflate the commodity price index by U.S. GDP deflator for the quarterly data and with U.S. CPI for the monthly data, to get the real commodity price index.

The *Canada-US 3-month interest rate spread* is based on the difference between the 3-month Canadian Prime Corporate Paper and the U.S. 3-month nonfinancial commercial paper (both from Haver Analytics).

The *Canada-US labor productivity differential* is measured by GDP per person employed in 2011 EKS dollar, computed by the Conference Board.

Canada domestic demand is based on national accounts data (Source: Haver Analytics).

A2. Panel Data (annual)

For the panel data regressions, we define the ***manufacturing sector*** to be SITC6 plus SITC7 plus SITC8, that is, manufactured goods and machinery & transport equipment. The non-energy sector is computed by excluding SITC3 from the SITC sectors.

SITC (=Standard International Trade Classification) data from Comtrade (United Nations), which are complied and documented in Feenstra *et al.* (2005).

SITC0 = food and live animals.

SITC1 = beverages and tobacco.

SITC2 = crude materials and inedible except fuels.

SITC3 = mineral fuels, lubricants and related materials.

SITC4 = animal and vegetable oils, fats and waxes.

SITC5 = chemicals and related products.

SITC6 = manufactured goods.

SITC7 = machinery and transport equipment.

SITC8 = miscellaneous manufactured articles.

SITC9 = commodities and transactions not classified elsewhere in the SITC.